ACTA BOTANICA

ACADEMIAE SCIENTIARUM HUNGARICAE

VOLUME 27 NOS 1–2

AKADÉMIAI KIADÓ, BUDAPEST

1981

ACTA BOT. HUNG.

ACTA BOTANICA

A QUARTERLY OF THE HUNGARIAN ACADEMY OF SCIENCES

Acta Botanica publishes original reports on botanical subjects in English, French, German, Spanish and Russian

Acta Botanica is published in yearly volumes of four issues by

AKADÉMIAI KIADÓ
Publishing House of the Hungarian Academy of Sciences
H-1054 Budapest, Alkotmány u. 21.

Manuscripts and editorial correspondence should be addressed to
Acta Botanica 1363 Budapest P.O. Box 24

Subscription information

Orders should be addressed to

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Volume 27

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REVIEWS

Acta Botanica Academiae Scientiarum Hungaricae, Tomus 27 (1—2), pp. 1—14 (1981)

XYLOTOMIC STUDY OF SOME WOODY PLANT SPECIES CUBA, III

By

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(Received: 1 July, 1978)

The authors describe the external morphology, distribution and ecology, the most important anatomical features of the xylem of another three Cuban species, namely: *Cordia Sebestena* L. (*Boraginaceae*), *Guazuma ulmifolia* LAM. (*Sterculiaceae*), *Quercus oleoides* C. & S. ssp. *sagraeana* (NUTT.) BORHIDI (*Fagaceae*).

Materials and Methods

Blocks of the different woods were softened (2—3 atm, in the 1 : 1 mixture of water—glycerine) in a J. BRINZER autoclave, then cross, tangential and radial sections were obtained. The sections were dyed in an alcoholic solution of the microdyestuff of Toluidin blue. The maceration of the xylem was performed by the Schulze's method (SÁRKÁNY and SZALAI 1964).

Length of the fibres and vessel elements, tangential and radial diameters of the vessels, width and height of the medullary rays, and other features were measured. Minimum-maximum values for each anatomic feature of individual species were calculated from 50—100 measurements.

Suitably enlarged microphotographs were prepared of each section.

External Morphology, Distribution and Ecology

Cordia Sebestena L.
(*C. speciosa* SALISB., *Sebesten sebestena* BRITT.)

Shrubs or trees up to 10 meters high, branchlets pubescent and setulous; leaves ovate to ellyptic or subcordate, 9—16 cm long and 5—14 cm wide, widest near the base, obtuse or acuminate at the apex, obtuse, rounded or subcordate at the base, scabrous above by short, rigid, appressed hairs with thickened discoidal bases, glabrescent or strigous beneath. Inflorescence many-flowered terminal corymbs. Calyx strigous and pubescent with brown hairs, elongate in buds, 12—15 mm long. Lobes 5, unequal, 2—3 mm long. Corolla orange or scarlet, tube two times as long as the calyx. Stamens 5, inserted in the throat of the corolla tube. Fruit dry corneous, ovate, acute, 1—2 cm long, calyx increased, fleshy, lobes 3—4 cm in the fruit.

This species grows in the coastal thickets, dry evergreen and deciduous shrubs, littoral forests in all the provinces of Cuba, further more in the Antilles, Florida and the tropical coastal regions of America. It is a widespread ornamental tree; the timber is used for fine carpentry and music instruments.

Guazuma ulmifolia LAM.
(*Theobroma Guazuma* L.; *Guazuma pervifolia* A. RICH.; *G. tomentosa* H. B. K.; *G. Guazuma* COCKERELL)
"Guásima", "Guásima de caballo"

Shrubs or mostly trees up to 25 m high, cortex brownish-gray, twigs puberulent with stellate hairs. Leaves oblong to ovate, 3—15 cm long, acute to long acuminate at the apex, rounded to cordate at the base, serrate at the margin, densely stellate-pubescent on both surfaces. Flowers yellow, fragrant, in short few-flowered axillar cymes; calyx 2—3-parted stellate-tomentose, petals 5, cucullate, 3 mm long, prolonged in a bifid ligule at the apex. Staminate tube 5-lobulate, anthers 3 per sines, stipitate. Ovary sessile, 5-lobulate, 5—10-cular, cavities multi-ovulate. Fruit in capsule lignous, globose or ovate, 2—4 cm long, with short hard tubercules on the surface. Seeds numerous.

A common tree in the tropical semideciduous forests and in the deciduous limestone carstic forest of the haystack mountains up to 450—500 m approximately. It occurs in all the
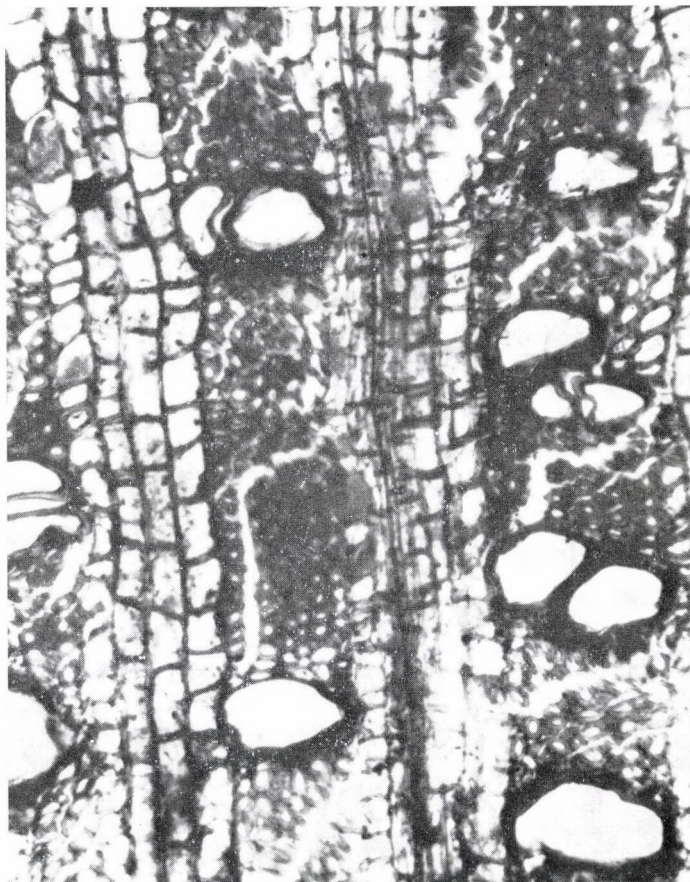
Fig. 1. Cordia sebestena L. Cross-section 120×
Wide medullary rays, vessels and fibres with thicker wall. Diffuse and contact-vasicentric longitudinal parenchyma

provinces of Cuba; its general distribution extends to the Antilles and to the tropical lowlands and submontane regions of the American continent.

The cortex and the juice of trunk are used as popular medicines. The timber is used for constructions and for charcoal.

Quercus oleoides CHAM. et SCHLECHT. ssp. *sagraeana* (NUTT.) BORHIDI (*Quercus sagraeana* NUTT., *Quercus cubana* A. RICH., *Quercus virginiana* auct cub. non MILL.) "Encina", "Encino"

Evergreen trees up to 25 m high. Leaves coriaceous, extremely variable in form and shape, mostly oblong, oblong-ellyptic, or lanceolate to oblanceolate, 3—12 cm long, obtuse or acute and mucronate at the apex, rounded or obtuse at the base, entire, undulate or irregularly lobulate at the margin, glabrous and lostrous above, tomentose beneath. Petiole 0.5—1 cm long. Male aments colgate in groups; Calyx campanulate, 4—7-lobulate. Stamens 6—12, filaments short. Female flowers solitary or in groups. Ovary generally 3-locular, ovules

Fig. 2. Cordia sebestena L. Radial section 120×
Vessel, heterogeneous medullary ray and fibres

2 in each cavity. Fruit in acorn 2—2.5 cm long, coriaceous, surrounded by a squamate cupule about 13—16 mm wide.

This isolated endemic Cuban subspecies of the Mexican-Central American *Qu. oleoides* is perhaps of a hybridogenic origin produced by an ancient introgression of *Qu. oleoides* and *Qu. virginiana* in some earlier geologic period (BORHIDI: in BORHIDI and MUÑIZ 1971). This subspecies is endemic in West-Cuba, Pinar del Rio Province and very rare in Isle of Pines. It grows on slightly acid soils on white sand, slate and sandstone rocks, on yellowish-gray pseudopodzolic, and sandy soils. It forms pure evergreen oakwoods or more frequently submontane Pine-oak forests mixed with *Pinus caribaea*, or lowland Pine-oak forests, mixed with *Pinus tropicalis*.

The cortex is used for popular medicines, the timber is used for all types of rural construction.

Wood Anatomy

Cordia sebestena L.

Wood porous diffuse; the ground mass of the wood is formed by polygonal-shaped fibres with thicker wall and narrow lumen and by wide medullary
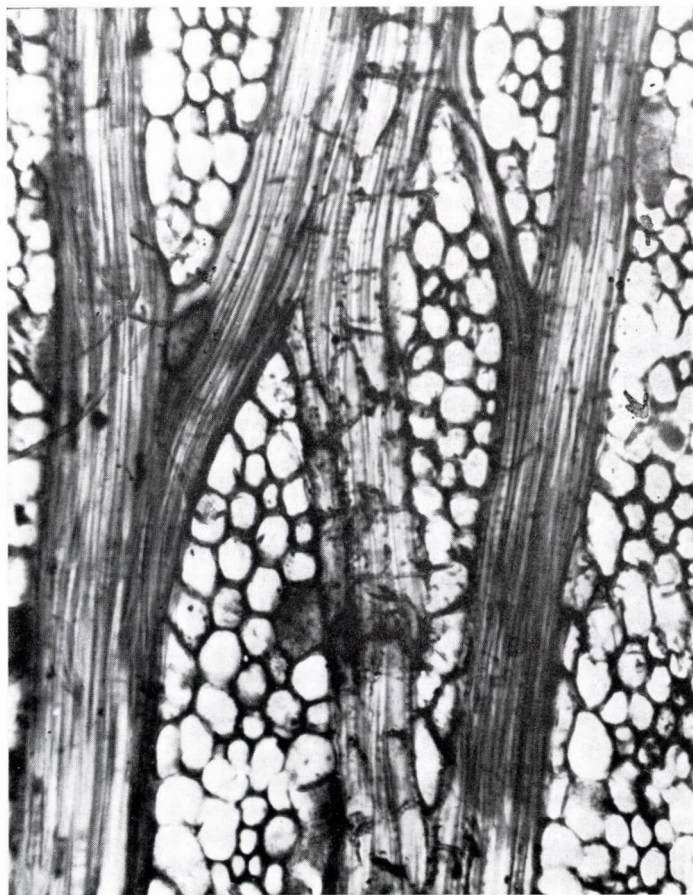
Fig. 3. Cordia sebestena L. Tangential section 120×
Wide heterogeneous medullary rays; crystal sand in the cells of the medullary rays (sign: →). Fibres

rays. Diffuse and contact vasicentric longitudinal parenchyma. Medullary rays with distinctly more cells in width, rarely with one cell in width (Fig. 1).

Tracheae are round or oval-shaped, often flattened in tangential direction, with medium sizes, and rarely contain mastic material. Number is 11 per 1 sq. millimeter. Tangential diameter 46.0—126.5 μ. Radial diameter 32.2—133.4 μ. Vessel members are 213.0—355.0 μ long, with small bordered pits alternately allocated on their wall. Perforation plate is simple, rarely with border. Tracheae often filled up by thyllis.

Heterogeneous medullary rays with 3—7, rarely 1 cell in width. Height 92.0—2127.0 μ. Width 23.0—184.0 μ. Cells of the medullary rays rarely contain polygonal-shaped crystals and crystal sand (Figs 2 and 3).
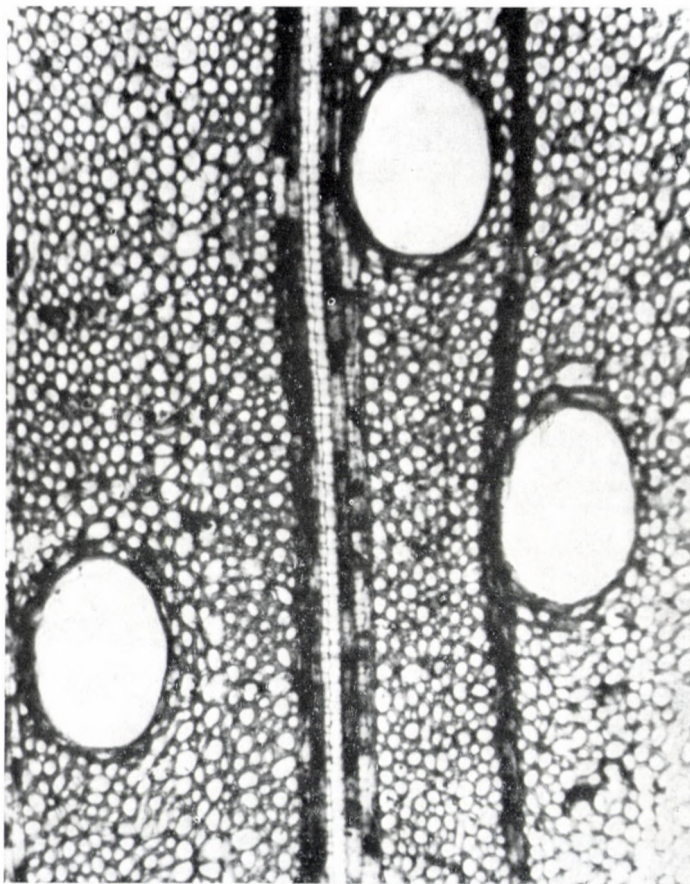
Fig. 4. Guazuma ulmifolia LAM. Cross-section 120 ×
Narrow and wide medullary rays, fibres with thin wall. Oval-shaped vessels with large size. Contact-vasicentric and diffuse grouped longitudinal parenchyma

Fibres arranged in irregular lines. Diameter 16.1—25.3 μ. Constant wall thickness 5.7 μ. Full length 426.0—1491.0 μ. Tips of the fibres ending in a peak, or forking. The cellular fibre is scarce.

Diameter of longitudinal parenchyma cells 9.3—23.5 μ. Height 51.1—125.5 μ. The cells often contain mastic material.

Guazuma ulmifolia LAM.

Wood porous diffuse. The ground mass of the wood is formed by fibre with thin wall and large lumen. Contact-vasicentric and diffuse-groupd longitudinal parenchyma (WAGENFÜHR and SCHEIBER 1974). Narrow and wies medullary rays (Fig. 4).

Fig. 5. Guazuma ulmifolia LAM. Radial section 120×
Heterogeneous medullary ray, mastic material in the cells of the medullary rays. Fibres and longitudinal parenchyma

Tracheae are oval-shaped; in the groups consisting of several members tracheae are flattened in tangential direction, sizes are relatively large, rarely with mastic content. Number 9 per 1 sq. mm. Tangential diameter 39.1—128.8 μ. Radial diameter 39.1—174.8 μ. Length of vessel members 284.0—497.0 μ. Small, alternative, oblong bordered pits on the walls. Simple perforation plate.

Medullary rays with one or two cells in width. Heterogeneous structure. Height 92.0—1690.5 μ. Width 11.5—138.0 μ. Number of the margin cell rows 2—4. Medullary ray cells rarely contain polygonal-shaped crystals and the mastic material is frequent (Figs 5 and 6).

Fibres arranged in irregular lines. Diameter 9.2—20.7 μ. Wall thickness 3.5—9.2 μ. Full length 852.0—2038.0 μ. The cellular fiber is not rare. Tips of the fibres ending in a smooth peak, sometimes with toothed margin.
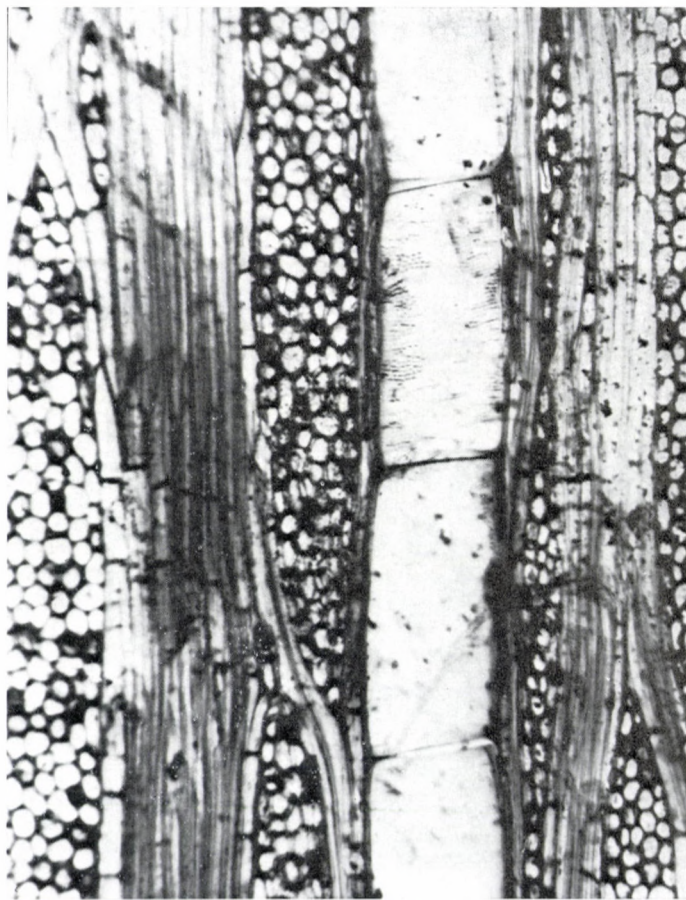
Fig. 6. Guazuma ulmifolia LAM. Tangential section 120×
Narrow and wide medullary rays. Vessel with clearly visible alternative, small, oblong bordered pits on the wall. Longitudinal parenchyma, fibre and cellular fibre

Diameter of longitudinal parenchyma cells 9.3—27.9 μ. Height 41.8—116.2 μ. The cells often contain mastic material and sometimes cellular crystal holder longitudinal parenchyma.

Quercus oleoides C. & S. ssp. *sagraeana* (NUTT.) BORHIDI

Wood material with growth-ring structure. The limit of the growth zone is clearly visible. The ground mass of the wood is formed by fibres with thick wall and narrow lumen. Apotracheal longitudinal parenchyma of network system. Medullary rays are narrow and widely accumulated (METCALFE and CHALK 1950, JANE 1956) (Figs 7 and 8).

Tracheae distinctly solitary, with roundish or oval shape, sometimes flattened in tangential direction. Small size in the relation of the oaks. Tracheae
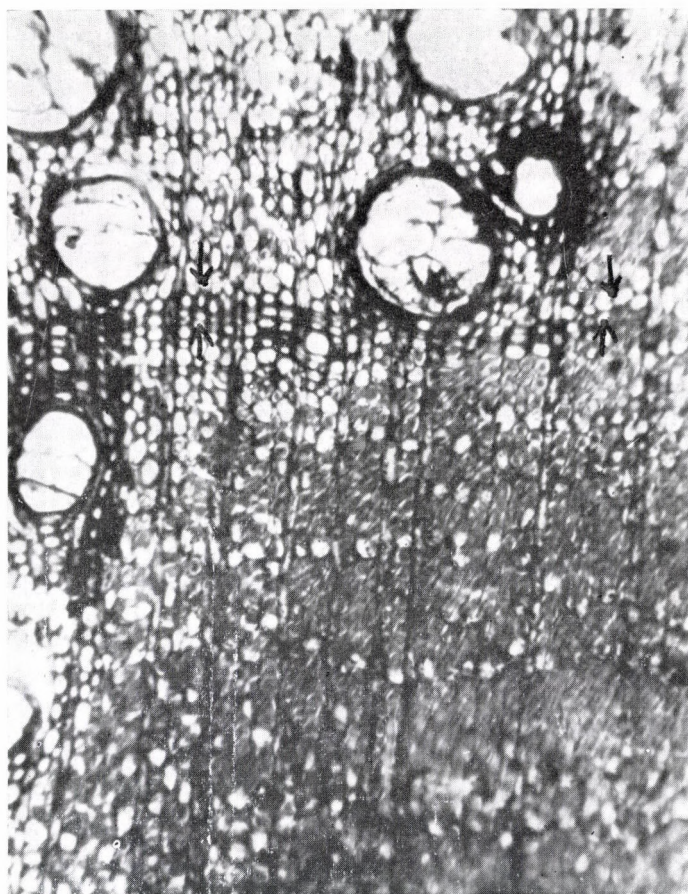
Fig. 7. Quercus oleoides C. & S. ssp. *sagraeana* (NUTT.) BORHIDI. Cross-section 120× Limit of the growth zone (sign: →). Vessels with content of thyllis and mastic. Fibre tracheid around the vessels. Apotracheal longitudinal parenchyma with network-system. Narrow medullary rays and fibres with thick wall and narrow lumen

contain a large amount of thyllis, but the mastic material is rare. Size of the vessels is greater in the juvenile part of the growth zone than in the mature part. Vessels of the growth zone are arranged in a "flamboyant" strip. Tangential diameter 36.8—138.0 μ. Radial diameter 34.5—161.0 μ. Length of vessel members 355.0—781.0 μ. Few alternative bordered pits on the walls. Simple perforation plate.

Medullary rays 1 and 3—8 cells in width. Heterogeneous structure. Height of the small medullary rays 80.5—333.5 μ; constant width 11.5 μ. Height of the large medullary rays 575.0—1840.0 μ, width 69.0—184.0 μ. Medullary ray cells contain polygonal-shaped crystal and mastic materia, (Figs 9 and 10).
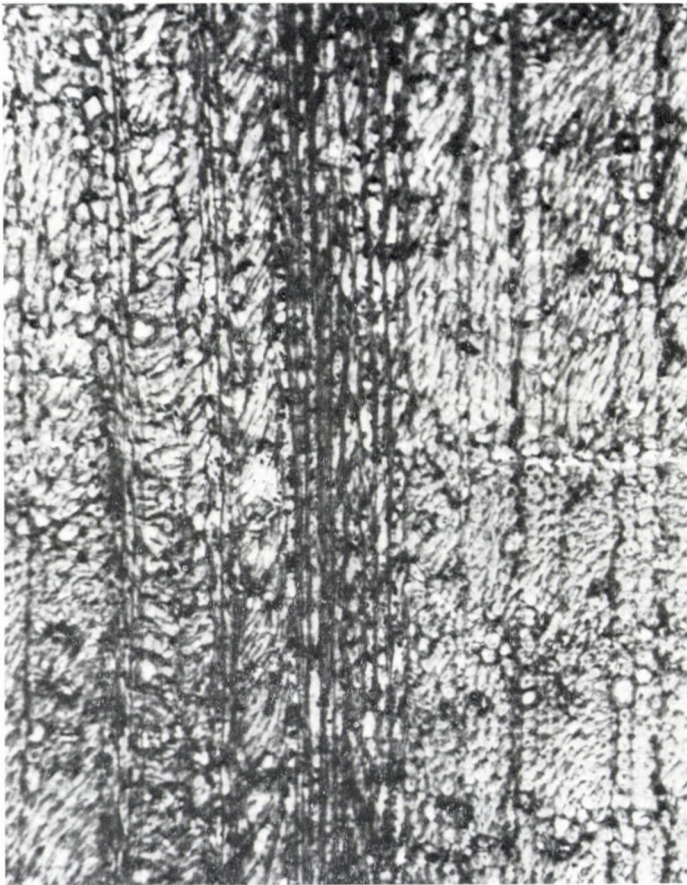
Fig. 8. Quercus oleoides C. & S. ssp. *sagraeana* (Nutt.) Borhidi. Cross-section 120×
Wide accumulated medullary ray and narrow medullary rays. Apotracheal longitudinal parenchyma with network-system and fibres with thick wall and narrow lumen

Fibres are arranged in irregular position. Diameter 9.2—16.1 μ. Wall thickness 3.9—6.9 μ. Full length 710.0—1775.0 μ. Small bordered pit on the radial and tangential wall of the fibres. Tips of the fibres end in a long peak, sometimes bifurcate. A large number of fibre tracheids around the vessels.

Diameter of longitudinal parenchyma cells 9.3—27.9 μ. Height 60.4—116.2 μ. The cells often contain mastic material. A large number of cellular crystal holder longitudinal parenchyma.

Detailed anatomical features of the three species are shown on Tables 1 and 2.
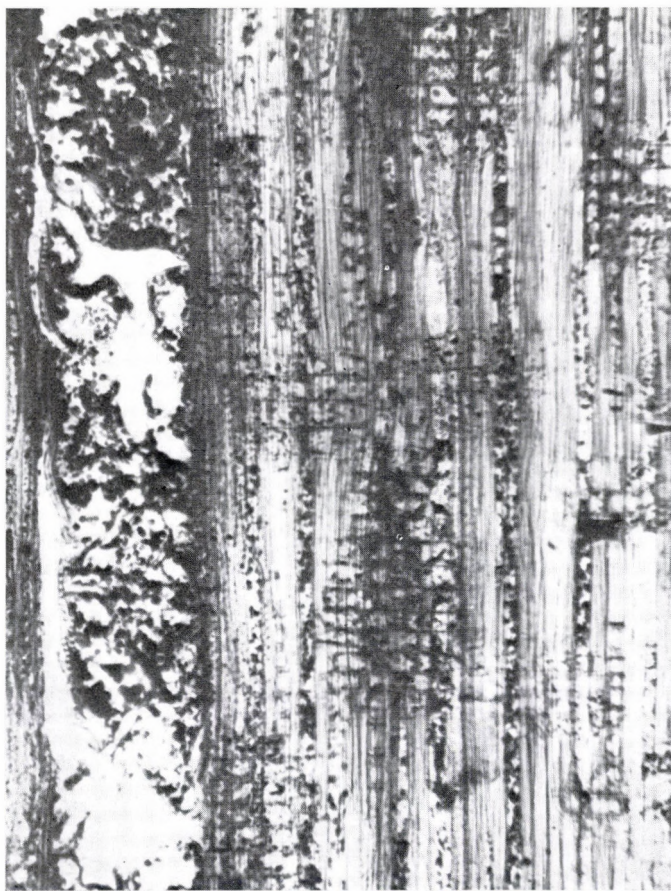
Fig. 9. Quercus oleoides C. & S. ssp. *sagraeana* (NUTT.) BORHIDI. Radial longitudinal section 120×
Vessel filled up with thyllis. Heterogeneous medullary rays. Cells of medullary ray and longitudinal parenchyma with mastic material. Crystal holder longitudinal parenchyma. Fibres
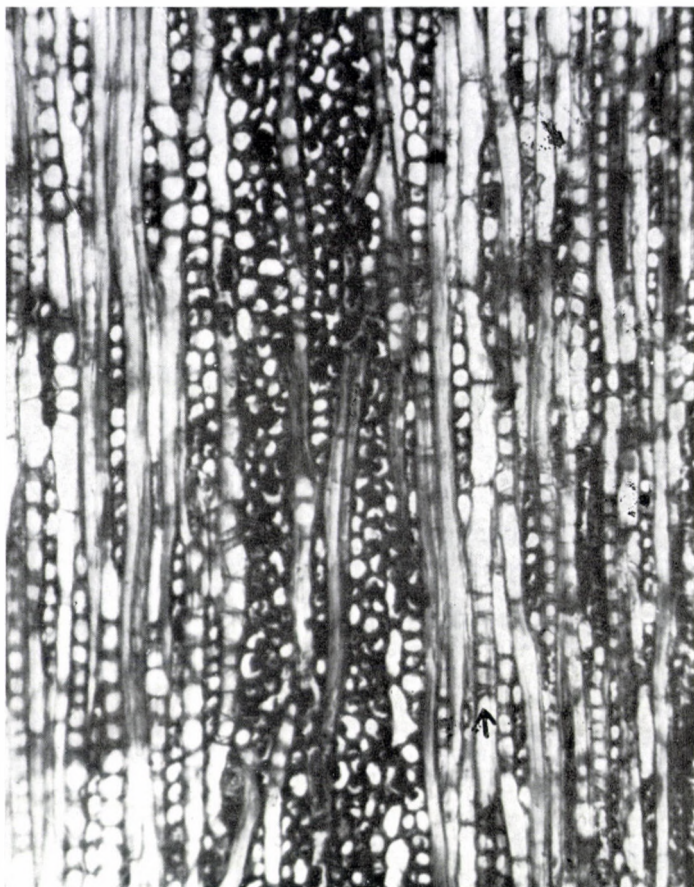
Fig. 10. Quercus oleoides C. & S. ssp. *sagraeana* (NUTT.) BORHIDI. Tangential section 120× Narrow and wide accumulated medullary rays. Fibres and longitudinal parenchyma. Cellular crystal holder longitudinal parenchyma (sign: →)

Origin of the samples

Cordia sebesteana L.: Cuba; Provincia Cabo San Antonio; Faro Roncali, Collected by M. VALES and A. BORHIDI, 15. 12. 1974.

Guazuma ulmifolia LAM.: Cuba; Provincia Habana; Escaleras de Jaruco. Collected by M. VALES, 9. 10. 1974.

Quercus oleoides C. & S. ssp. *sagraeana* (NUTT.) BORHIDI.: Cuba; Provincia Pinar del Rio; Pinar Sobre pizarra entre la Palma y Jagua Pinar del Rio. Collected by M. VALES and A. BORHIDI, 23. 11. 1974.

Table 1

Anatomical features of the examined species

Elements	Features	*Cordia sebestena*	*Guazuma ulmifolia*
Trachea members	arrangement	diffuse, solitary, sometimes groups of 2—3 members	diffuse, solitary, rarely radial group of 3—5 members
	shape	oval and roundish or flattened in tangential direction	oval or flattened in tangential direction
	tangential diam., μ	46.0— 126.5	39.1— 128.8
	radial diameter, μ	32.2— 133.4	39.1— 174.8
	wall thickness, μ	2.3— 9.3	2.3— 6.9
	length of vessel members, μ	213.0— 355.0	284.0— 497.0
	number per sq. mm.	11	9
	intervascular pitting	small, bordered	oblong, bordered
	perforation plate	simple, rarely flanged	simple
	content	rarely mastic	rarely mastic
Medullary rays	width	narrow and wide	narrow and wide
	number of cells	1 — 3—7	1 — 7
	classification	heterogeneous	heterogeneous
	height, μ	92.0—2127.0	92.0—1690.5
	width, μ	23.0— 184.0	11.5— 138.0
	content of cell	crystal sand, columnar crystal	mastic material, rarely columnar crystal
Fibres	arrangement	irregular	irregular
	shape	polygonal	polygonal
	full diameter, μ	16.1— 25.3	9.2— 20.7
	wall thickness	5.7	3.5—9.2
	full length, μ	426.0—1491.0	852.0—2038.0
	type of pitting	simple	simple
Longitudinal parenchyma	arrangement	contact-vasicentric and diffuse	contact-vasicentric and diffuse-grouped
	diameter, μ	9.3— 23.5	9.3— 27.9
	height, μ	51.1— 125.5	41.8— 116.2
	number of cells	1	1
	content	mastic	mastic
	other	—	rarely cellular crystal holder parenchyma

Table 2

Anatomical features of the examined species

Elements	Features	*Quercus oleoides* ssp. *sagreana*
Trachea members	arrangement	solitary
	shape	roundish or oval, sometimes flattened in tangential direction
	tangential diameter, μ	36.8— 138.0
	radial diameter, μ	34.5— 161.0
	wall thickness, μ	2.3— 6.9
	length of vessel members, μ	355.0— 781.0
	number per sq. mm.	11 (measured in the "flamboyant" zone)
	intervascular pitting	bordered
	perforation plate	simple
	content	thyllis, rarely mastic
Medullary rays	width	narrow; accumulated, wide
	number of cells	1 — 8
	classification	heterogeneous
	height, μ	narrow: 80.5— 333.5 wide: 575.0—1840.0
	width, μ	narrow: 11.5 wide: 69.0— 184.0
	content of the cell	columnar crystal, mastic
Fibres	arrangement	irregular
	shape	polygonal
	full diameter, μ	9.2— 16.1
	wall thickness, μ	3.9— 6.9
	full length, μ	710.0—1775.0
	type of pitting	simple-flanged
Longitudinal parenchyma	arrangement	apotracheal, with network system
	diameter, μ	3.9— 6.9
	height, μ	60.4— 116.2
	number of cells	1 — 2
	content	mastic
	other	cellular crystal holder parenchyma

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Acta Botanica Academiae Scientiarum Hungaricae, Tomus 27 (1–2), pp. 15–19 (1981)

ZUSAMMENHANG ZWISCHEN DEN REDUZIERENDEN ORGANISCHEN STOFFEN UND DER SCHÄDIGUNG DURCH PHYTOPHAGE HETEROTROPHE ORGANISMEN BEI DER STRAUCHART *ACER CAMPESTRE**

Von

Cs. Béres

L. KOSSUTH UNIVERSITÄT, INSTITUT FÜR ÖKOLOGIE, DEBRECEN

(Eingegangen: 5. Februar 1980)

Acer campestre is a dominant shrub species in the Quercetum petraeae-cerris forest of the Hungarian MAB sample area at Síkfőkút. Phytophagous heterotrophs consume intensely the leaves of this shrub species during springtime. Concentration changes of the reducing organic materials of the shrub was studied in 1978. For sampling not damaged shrub individuals (type a) and heavily damaged ones (type b) were selected. In the second group three varieties of leaves were analysed: intact leaves of chewed shrubs (b_1), remains of destroyed leaves (b_2) and leaves of the young shoots developing simultaneously with the insect chewing (b_3). It was stated that phenols and polyphenols were represented in very low concentrations in the leaves remained intact on the damaged shrubs and in the remains of the chewed leaves, in opposite with the recent leaves of the young shoots developed on the damaged shrubs. The concentration values of the free sugar fraction easily utilizable as food showed an inverse arrangement in the period of the main damage in comparison with those of the earlier one. These two facts seem to permit suppose that the phytophagous heterotrophs do not damage by evenness the individuals of the same shrub species in different extent. The individuals of a higher free sugar content and containing lower concentrations of phenolic and polyphenolic derivates may be more »attractive« for damaging agents.

Im Eichenwald (*Quercetum petraeae-cerris*) der ungarischen MAB-Probefläche kann seit 1972 jedesmal im Spätfrühling eine bedeutende Raupengradation beobachtet werden. Die phytophagen Organismen üben eine schädigende Wirkung sowohl auf die Blätter der Bäume, wie auch auf die der Sträucher aus. Es wurde jedoch festgestellt, dass die Raupen die zur derselben Art gehörenden Bäume, bzw. Sträucher in verschiedenem Masse verzehren. Es kommen Pflanzenindividuen vor, deren Blätter zu 80–90% verzehrt werden, während andere kaum, oder überhaupt nicht berührt werden. Wir versuchten im Laufe unserer Untersuchungen die Frage zu beantworten, ob in den Konzentrationen der reduzierenden organischen Stoffe der durch Phytophagen verzehrten Individuen derselben Pflanzenart gewisse Unterschiede wahrzunehmen sind. Handley (1961), Feeny–Bostock (1968), Feeny (1967, 1970) haben im Laufe ähnlicher Untersuchungen bereits Zusammenhänge zwischen den Konzentrationen von freien Zuckern, Aminosäuren und Phenolderivaten und dem Masse der Schädigung durch Phytophagen in Blättern nachgewiesen.

Aus der artenreichen Strauchschicht des »Síkfőkút Project«-Waldes (Jakucs 1978, 1982) haben wir die Art *Acer campestre* für unsere Untersuchungen gewählt. Dieser Strauch ist eine der am häufigsten auftretenden (7604 Stück ha^{-1}), ferner hohe Blattzahl (3 495 675 Stück ha^{-1}) und grosses Blattgewicht (199.07 kg ha^{-1} in Trockensubstanz) zeigenden Arten im Wald (Kárász 1976); sein Blattflächenindex weist unter den Sträuchern den

* »Síkfőkút Project« No. 57.

höchsten Wert auf (0,565 ha ha^{-1}, JAKUCS in JAKUCS 1982). Im Untersuchungsjahr 1978 haben die Phytophagen (hauptsächlich *Lepidoptera*-Arten) 70—75% der Blätter von *Acer campestre*, etwa 140—150 kg organisches Material je Hektar verzehrt (LAKATOS—VARGA—SZABÓ mscr.).

Probeentnahme und Methode

Es wurden im Jahre 1978 drei Probeentnahmen vorgenommen: im Spätfrühling, zur Zeit des intensiven Raupenfrasses (am 14. Juni), im Spätsommer (am 30. August) und im Herbst, vor dem Laubfall (am 12. Oktober).

Zur Einsammlung der Blätter wurden 10 — durchschnittliche Höhe und Blattzahl zeigende (s. KÁRÁSZ 1976) — Sträucher ausgewählt. Von diesen blieben fünf Sträucher von den Raupen unbeschädigt (Typ: a), fünf Sträucher wurden dagegen zu 60—70% von den Raupen verzehrt (Typ: b). Von den Strauchindividuen des Typs b (in hohem Masse verzehrt) wurden die Blätter aufgrund weiterer drei Gruppierungen eingesammelt: b_1 = unverzehrt gebliebene Blätter, b_2 = Reste (Blattscheibenstümpfe) der von den Raupen gefressenen Blätter, b_3 = junge Blätter, sog. »Johannestagesblätter«, die sich in der Frassperiode auf den neuen Sprossen entwickelt haben. In allen drei Probeentnahmeperioden wurden aus sämtlichen Typen, bzw. Varianten je 50—50 Blätter eingesammelt, wobei darauf bedacht wurde, dass die Proben die gegebenen Typen, bzw. Varianten repräsentieren sollen (das Äussere-Innere des Strauches, sein oberer, bzw. unterer Teil, usw.).

Die Blätter wurden abgepresst, sodann ihre Flächen mit einem Lichtplanimeter gemessen. Sie wurden dann bei 85 °C bis zur Gewichtskonstanz getrocknet und je nach Proben abgewogen. Im weiteren sind die besonders behandelten Typen-, bzw. Variantenproben der zehn Sträucher bis zur Mehlfeinheit verstaubt und aus diesen parallel 6—6 chemische Analysen verfertigt worden. Die gewonnenen und bei der Wertung angewendeten Daten bilden die Mittelwerte der eingehenden Analysen der einzelnen Typen, bzw. Varianten.

Die reduzierenden organischen Stoffe wurden mittels der Mikro-Schoolschen Methode bestimmt (DEMECZKY—JENEY 1958). Wir wählten — trotz ihrer Fehlerquellen — diese Methode, da wir auf diese Weise ausser den Kohlenhydraten auch über die sonstigen reduzierenden Stoffe Informationen gewinnen konnten. Im Laufe der Bestimmung haben wir 4 Fraktionen getrennt, während weitere zwei Fraktionen aus den Daten berechnet wurden:
Fraktion A = Menge der freien reduzierenden Stoffe nach der Hydrolyse
Fraktion B = Menge sämtlicher reduzierender Stoffe nach der Hydrolyse
Fraktion C = freie Zucker
Fraktion D = Menge sämtlicher reduzierender Kohlenhydrate nach der Hydrolyse
A—C = Approximation der Menge von Phenolen
B—D = Approximation der Menge von Polyphenolen

Die gewonnenen Werte wurden in mg auf 1 g Trockensubstanz (I), teilweise hingegen auf die in einem — durchschnittliche Grösse und mittleres Gewicht zeigenden — Blatt befindliche abgepresste, planimetrierte und abgewogene Trockensubstanz (II) angegeben.

Ergebnisse und Wertung

Die Messergebnisse sind in Tabelle 1 angegeben, die berechneten Werte der Phenole und Polyphenole wurden (für die Frühlingsperiode) in Abb. 1 dargestellt.

Auf 1 g Trockensubstanz berechnet sind die Konzentrationswerte der reduzierenden organischen Stoffe der Blätter im Frühling am höchsten. Diese
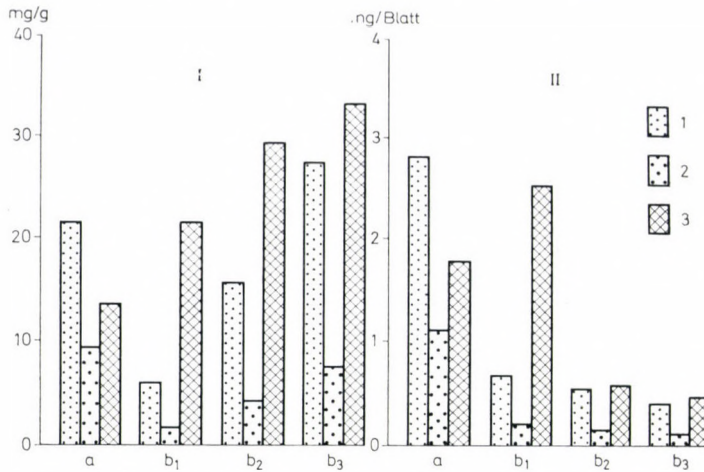
Abb. 1. Mengengestaltung von Phenolen (1 = A—C), Polyphenolen (2 = B—D) und freien Zuckern (3 = C) auf 1 g Trockensubstanz (I), bzw. auf ein durchschnittliches Blatt (II) bezogen, in mg, in der Hauptfrassperiode (14. Juni 1978). — a = Blätter unbeschädigter Sträucher, b_1 = unverzehrt gebliebene Blätter beschädigter Sträucher, b_2 = stark beschädigte Blattreste beschädigter Sträucher, b_3 = Blätter der frühsommerlichen Sprosse beschädigter Sträucher

Tabelle 1

Zusammenhänge zwischen den laubfressenden phytophagen Organismen und der Gestaltung der in den Blättern befindlichen reduzierenden organischen Stoffe bei der Strauchart Acer campestre in 1978

(I = auf 1 g Trockensubstanz, II = auf ein durchschnittliches Blatt berechnet, in mg, die A = Menge der freien reduzierenden Stoffe nach der Hydrolyse, B = Menge sämtlicher reduzierender Stoffe nach der Hydrolyse, C = Menge der freien Zucker, D = Gesamtmenge der reduzierenden Kohlenhydrate nach der Hydrolyse; a = unbeschädigte Strauchblätter, b_1 = unverzehrte Blätter von beschädigten Sträuchern, b_2 = Blattreste beschädigter Blätter an beschädigten Sträuchern, b_3 = Blätter neuer Sprosse in beschädigten Sträuchern)

Zeit der Probeentnahme	Typ und Variante	I				II			
		A	B	C	D	A	B	C	D
14. 6	a	35,15	37,36	13,64	28,24	4,61	4,90	1,79	3,79
	b_1	27,69	35,00	21,73	33,30	3,22	4,08	2,53	3,88
	b_2	31,79	33,63	15,87	29,49	1,13	1,23	0,58	1,08
	b_3	62,12	63,87	33,44	56,46	0,91	0,94	0,49	0,83
30. 8	a	16,94	24,58	7,94	16,99	1,45	2,11	0,68	1,46
	b_1	16,19	16,94	9,29	16,48	1,29	1,35	0,74	1,32
	b_2	24,19	25,78	13,24	19,79	1,86	1,98	1,02	1,52
	b_3	25,75	27,50	7,65	15,95	1,84	1,96	0,53	1,14
12. 10	a	21,51	23,81	18,22	20,17	1,80	2,00	1,58	1,69
	b_1	19,18	29,62	10,02	15,40	1,63	1,72	0,81	1,14
	b_2	22,07	21,84	14,66	20,79	1,91	1,89	1,27	1,80
	b_3	23,31	24,64	11,60	16,34	1,69	2,61	0,88	1,36

Werte nehmen im Sommer ab und werden im Herbst, vor dem Laubfall, wieder höher. Dieser saisonale Gang ist der jährlichen Gestaltung der reduzierenden organischen Stoffkonzentrationen anderer Sträucher des Waldes ähnlich (BÉRES 1980). Die hohen Frühlingswerte weisen darauf hin, dass in der Wachstumsperiode die Rolle der reduzierenden organischen Stoffe bedeutender als später ist.

Dieselbe Tendenz ist wahrzunehmen falls wir die Werte auf ein durchschnittliches Blatt beziehen. In den sich später entwickelnden und ihre maximale Blattgröße erst im Herbst erreichenden Blättern der Sommersprosse (Variante b_3) kann die kontinuierliche Zunahme der reduzierenden organischen Stoffe ganz bis zum Herbst beobachtet werden.

Die Menge der Phenole (Abb. 1) ist in der Frühlingsperiode — zur Zeit der Schädigung durch Phytophagen — eindeutig in den Blättern der von den Phytophagen unbeschädigt gebliebenen Sträucher am höchsten. Das gleiche kann auch bei den Polyphenolen beobachtet werden. Wenn wir unsere Messungen in 1 mg g^{-1} angeben, sind obige zwei Fraktionen (Phenol, Polyphenol) auch in den Blättern der jungen, neuen Sprosse der beschädigten Sträucher hoch, diese hohe Phenolkonzentration besteht jedoch in diesen Blättern das ganze Jahr hindurch. Wir bemerken hier, dass die durch Phytophagen hervorgerufenen Schädigungen dieser »Johannestagesprosse« im allgemeinen minimal ist.

In den Blättern jener Sträucher, an denen keine durch Phytophagen verursachte Schädigung zu beobachten war (Typ a), nahm die Phenolkonzentration bis zum Herbst in grossem Masse ab. In den abgefressenen Blattresten (b_2) der beschädigten Sträucher nimmt die Phenolkonzentration im Sommer in einem kleinen Maße zu, jedoch zur Zeit der Herbstprobeentnahme sind sämtliche reduzierenden organischen Stoffraktionen im allgemeinen bei allen drei Varianten sowohl im Falle des unbeschädigten, wie auch des beschädigten Typus einander ähnlich.

Die Phenole und Polyphenole zeigen im Frühling in den unverzehrten Blättern der beschädigten Sträucher (b_1), sowie in den Blattresten nach dem Raupenfrass (b_2) immer eine niedrige Konzentration. In dieser Periode sind die Werte der als Nährstoffe leicht zugänglichen freien Zucker (Fraktion C) eher in den beschädigten Sträuchern und in ihren beschädigten Blättern höher als in den Blättern der unbeschädigten Sträucher. Diese zwei Tatsachen scheinen die Hypothese zu unterstützen, dass — offenbar neben anderen Faktoren — die phytophagen Organismen nicht zufallsmässig die Individuen derselben Strauchart in verschiedenem Masse beschädigen. Der Strauch mag für sie mehr »attraktiv« sein, in dem der Wert freier Zucker höher ist, während die Konzentrationan der Phenol- und Polyphenolderivate gleichzeitig niedriger sind.

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Acta Botanica Academiae Scientiarum Hungaricae, Tomus 27 (1—2), pp. 21—36 (1981)

RUBIÁCEAS CUBANAS, I
RANDIA L. Y *SHAFEROCHARIS* URB.

Por

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Author publishes a recent revision of the Cuban taxa of the genera *Randia* L. and *Shaferocharis* URB., both from *Rubiaceae*. New analytic keys, completed and detailed generic and specific descriptions, geographic distribution and ecologic dates are published. The problem of polymorphic *Randia aculeata* L. is also discussed.

Four species: *Randia costata* BORHIDI, *R. cubana* BORHIDI and *R. acunae* BORHIDI, further *Shaferocharis villosa* BORHIDI et BISSE are new to science.

Introducción

El proyecto de la "Nueva Flora de Cuba" esta realizandose en la organización del Jardin Botánico de la Universidad de Habana con la participación de unos 50 taxónomos cubanos y extranjeros (de la Republica Democrática Alemana, Unión Soviética, Hungria). Dentro del proyecto la familia de las Rubiáceas va ad investigarse por Mayra FERNANDEZ ZEQUEIRA y Attila BORHIDI, como responsables co-editores encargados de esta familia, contando con la valiosa ayuda de otros expertos, como Magda JÁRAI-KOMLÓDI, Milagros MONCADA, Maria del Carmen FERNANDEZ, etc.

Rubiaceae es la familia mas grande, mas rica en espécies en la Flora de Cuba, que contiene cerca de 80 géneros y 500 espécies aproximadamente. Las revisiones taxonómicas van a publicarse succesivamente en las revistas cientificas cubanas y húngaras respectivamente. Las primeras revisiones se confeccionaron ya y estan en la prensa: *Ariadne* URB. (por M. FERNANDEZ en la Ciencias Biológicas de la Academia de Ciencias de Cuba, ined.), *Casasia* GRISEB. (por M. FERNANDEZ y A. BORHIDI, Ciencias Biológicas, ined.), *Machaonia* H. et B. (por A. BORHIDI y M. FERNANDEZ, Ciencias Biológicas, ined.), *Acunaeanthus* BORHIDI, JÁRAI-KOMLÓDI et MONCADA y *Neomazaea* KRUG et URB. (por A. BORHIDI, M. JÁRAI-KOMLÓDI y M. MONCADA, Acta Bot. Acad. Sci. Hung. 26 (3—4.); en preparación: *Scolosanthus* (por A. BORHIDI), *Antirhea* (por M. FERNANDEZ y A. BORHIDI), *Acrosynanthus* (por A. BORHIDI) y *Rondeletia* (por M. FERNANDEZ).

A continuación sigue la revisión taxonómica de los taxones cubanos de los géneros *Randia* L. y *Shaferocharis* URB.

RANDIA L.

Árboles o arbustos (las espécies cubanas son arbustos o a veces arbolitos), comunmente con espinas axilares o supraaxilares, a veces las espinas terminales sencillas o trifurcadas en las ramitas. Estipulas pequeñas, intrapeciolares, a menudo connadas. Hojas opuestas, membranáceas a coriáceas, caducas a siempreverdes. Flores comunmente hermafróditas o unisexuales, mayormente axilares o terminales; cáliz tubular, lobulado o truncado, lóbulos alargados o foliáceos (en las espécies cubanas el cáliz truncado, los lóbulos muy pequeños y cortos); corola embudada, acampanada o asalvillada, lóbulos 5, cortos o alargados, contortos en el botón; estambres 5, insertos en la garganta de la corola, filamentos cortos o inconscpicuos, anteras dorsífijas, lineares; ovario comunmente 2-, a veces 3—4-locular; estigma entero, 2-dentado o 2-lobulado; óvulos numerosos, fruto en baya 2-locular; pericarpio fino u grueso, semillas numerosas o pocas, endospermio córneo.

Espécie típica: *Randia aculeata* L.

Clave para las espécies cubanas:

1 a Ramitas inermes o con espinas axilares sencillas 2
b Ramitas con espinas trifurcadas terminales 3
2 a Hojas glabras, mayormente membranáceas, calloso-punteadas en el haz, nervios laterales prominulos en el envés, corola 6—8 mm de largo, garganta vellosa .... **1. R. aculeata L.**
b Hojas de margen ciliado, cuando jóvenes, mayormente cartáceas, suborbiculares, nervios laterales hundidos en el envés; corola de 10—12 mm de largo, garganta glabra .... **2. R. ciliolata Wr. in Sauv.**
3 a Hojas cartáceas a coriáceas de 0.3—2 cm de largo, negruzcas cuando secas, nervios hundidos en el haz; fruto globoso, no acostillado 4
b Hojas membranáceas, suborbiculares a obovadas de 2—3 cm de largo, no negruzcas cuando secas, nervios prominulos en ambas caras; fruto globoso, ligeramente acostillado .... **3. R. costata Borhidi**
4 a Hojas cartáceas de 1—2 cm de largo, elípticas a oblongo-obovadas, atenuadas y mayormente agudas en el ápice; lóbulos del cáliz lineal-lanceolados de 3—5 mm de largo, reflejos en el fruto .... **4. R. cubana Borhidi**
b Hojas coriáceas de 0.3—1.2 cm de largo, obovadas a suborbiculares, redondeadas a truncadas en el ápice; lóbulos del cáliz muy cortos, rectos en el fruto 5
5 a Ramitas, hojas y flores glabros .... **5. R. spinifex (Roem. et Schult.) Standl.**
b Ramitas y hojas densamente hirsutas, cáliz pubérulo a glabrescente, corola pelosa por fuera .... **6. R. acunae Borhidi**

1. Randia aculeata L. s.l.

Randia latifolia LAM. Encycl. **3:** 24. 1789; *Gardenia* AIT. Hort. Kew. **1:** 295. 1789; *Gardenia Randia* Sw. Fl. Ind. Occ. 526. 1797; *Randia obovata* KUNTH in H. B. K. Nov. Gen. et Spec. **3:** 409. 1819, non *R. obovata* RUIZ et PAV. 1799; *Genipa aculeata* MAZA Anal. Soc. Esp. Hist. Nat. **23:** 288. 1894; *Mussaenda rotundifolia* SESSÉ et MOC. Fl. Mex. ed. 2. 59. 1894; *Rondeletia spinosa* K. SCHUM. Bull. Herb. Boiss. **3:** 620. 1895; *Randia spinosa* LOES. Verh. Bot. Ver. Prov. Brand. **65:** 109. 1923, non *R. spinosa* POIR. 1811)

Arbusto o arbolito de 1—6 m de alto, muy ramoso, comunmente espinoso, con espinas axilares opuestas o terminales divaricadas de 0.5—1.5 cm de largo, mayormente ascendentes, ramitas glabras o pelositas; estipulas de hasta 2 mm de largo, aovado-deltoideas, comunmente acuminadas, glabras o escabérulas por fuera, pelosas por dentro en la base; peciolo muy corto o subnulo, marginados hasta la base. Hojas de forma, tamaño y textura muy variables, mayormente obovadas, obovado-orbiculares, orbiculares, obovado-oblongas a rómbico-aovadas de 0.6—11 cm de largo y 0.5—6 cm de ancho, comunmente cerca de 3 cm de largo y 1.5 cm de ancho, agudas a redondeadas en el ápice, redondeadas a atenuadas en la base, a veces algo pelosas en el envés en el nervio medio, glabras y brillantes en el haz, coriáceas cuando adultas; nervios laterales 3—6 pares, comunmente promínulos en el haz y algo hundidos en el envés, el margen plano o subrevoluto. Flores hermafróditas, terminales, sésiles, solitarias a menudo agrupadas; cáliz e hipantio de 2—3 mm de largo, comunmente glabros, lóbulos lineares, triangulares, oblanceolados o aovados, comunmente mucho mas cortos que el hipantio, a menudo ciliolados; corola blanca, de 6—8 mm de largo, glabra por fuera, el tubo cilindraceo, la garganta vellosa, lóbulos aovados o aovado-oblongos, agudos o acuminados igual o mas largo del tubo; anteras sentadas exsertas; fruto globoso de 6—13 mm de diámetro, comunmente liso y glabro, ceroso azul cuando maduro; semillas mayormente 5—10, redondeadas de 3.5—5 mm de largo, parduzco-negras.

Esta descripción fue compilada por STANDLEY (N. Amer. Fl. **32:** 174, 1934) generalizada para todas las poblaciones norteamericanas de esta espécie. Esta misma fue adaptada en forma abreviada por Alain (Fl. de Cuba **5:** 65, 1962) dejando fuera de atención el hecho, que las características enumeradas en la misma, no en todo concuerdan con las de las poblacinoes cubanas. La figura de la *Randia aculeata* adaptada de la Flora of Jamaica de FAWCETT y RENDLE, tampoco es completamente identica con un ejemplar tipico cubano de esta espécie. Sobre todo en la forma de las hojas se nota diferencia y la forma y tamaño de los lóbulos del cáliz son también distintos por lo menos en algunas poblaciones cubanas.

ADAMS (Flower. Pl. Jam. 713. 1972) distingue tres variedades dentro del marco de la espécie de *Randia aculeata* L. La var. *aculeata* esta caracterizada en tener ramitas espinosas, hojas y ramitas glabras, hojas coriáceas, rígidas, de 1—4 cm de largo, y de 7—25 mm de ancho, estrechadas en la base. La var. *jamaicensis* (SPR.) ADAMS se distingue en tener ramitas, hojas y flores pelosas for fuera, y las hojas truncadas a subacorazonadas en la base. La var. *mitis* (L.). GRISEB. difiere en tener ramitas mayormente inermes, hojas foliáceas, de 3—8 cm de largo y 1,5—4 cm de ancho, estrechadas en la base. Las dos variedades ultimas estan consideradas por el autor, como endémicas de Jamaica.

Al revisar el material cubano de esta espécie, lo que llama el atención, que la plantas cubanas no tienen hojas coriáceas, sino membranáceas a subcartáceas, suaves al tacto, caedizas y negruzcas al secar. Por su textura semejan a las de la var. *mitis*, pero por su tamaño y por tener ramas espinosas, difieren también de ella. Es posible, que se trate de una variedad o subespécie no descrita cubana o de distribución mas amplia. Para resolver este y los demás problemas presentados en la taxonomía de esta espécie, se requiere una revisión completa, abarcando los materiales originados de toda su area.

2. Randia ciliolata C. Wright in Sauv.
(Anal. Acad. Cien. Habana **6:** 100. 1869;)

Genipa ciliolata Maza (Anal. Soc. Esp. Hist. Nat. **23:** 288. 1895)

Arbusto de hasta 2 m de alto, ramitas grisáceas, estrigilosas cuando jóvenes, espinosas; espinas axilares opuestas o terminales divaricadas de 0.6—1.2 cm de largo. Estípulas muy pequeñas, pelosas por dentro en la base. Pecíolo de hasta 4 mm de largo, marginado hasta la base. Hojas fasciculadas en las ramitas laterales cortas, u opuestas, orbiculares, ovales, redondo obovadas o elíptico-oblongas, de 1.5—3.2 cm de largo y 0.8—3.2 cm de ancho redondeadas y obtusas en la base, abruptamente decurrentes en el pecíolo, muy obtusas o redondeadas en el ápice, subcoriáceas, cilioladas en el margen cuando jóvenes; el limbo glabro en ambas caras, subcoriáceo a cartáceo, brillante en el haz, el nervio medio hundido en el haz, prominente en el envés, los laterales 3—5 pares poco visibles en el haz, algo hundidos en el envés, el margen subrevoluto. Flores hermafróditas, terminales, solitarias, sésiles. Cáliz y hipantio de 2.5 mm de largo, glabros, lóbulos 5, diminutos, subulados; corola de 10—12 mm de largo, glabro por fuera, el tubo cilíndrico, glabro en la garganta, lóbulos 5, aovados, acuminados, mas cortos que el tubo; anteras sentadas, poco exertas. Fruto globoso, de 2 cm in diámetro, poco tuberculado, semillas numerosas.

Es un endémico regional de las costas áridas, mayormente calizas de las provincias de Cuba Oriental (Tunas, Holguin, Granma, Santiago, Guantánamo-Baracoa) Vive en los matorrales espinosos costeros de la zona árida de Cuba.

3. Randia costata Borhidi sp. nova

Frutex ramosus, spinosus. Rami veteriores albescentes, teretes, longitudinaliter striati, glabri, laterales 4—6 cm longi, trifurcati, in spinas trifurcatas usque ad 1.5 cm longas terminati. Folia obovata, 1—3 mm longe petiolata vel subsessilia, antice rotundata vel obtusa, basi longe cuneata et in petiolum protracta, 1.5—3 cm longa et 0.9—2.2 cm lata, nervo medio utrinque prominulo, lateralibus utroque latere 3—5, utrinque leviter prominulis, subtus laxe anastomosantibus et ante marginem conjunctis, lamina supra nitida, subtus opaca et pallida, utrinque glabra, margine integra, plana, membranacea, valde caduca. Flores non visi. Fructus sessilis, globosus, leviter (5—)—10 costatus et lenticellatus, 2—2.5 cm longus, 2 cm latus, 2-locularis, semina numerosa in quoque loculo; endospermium corneum.
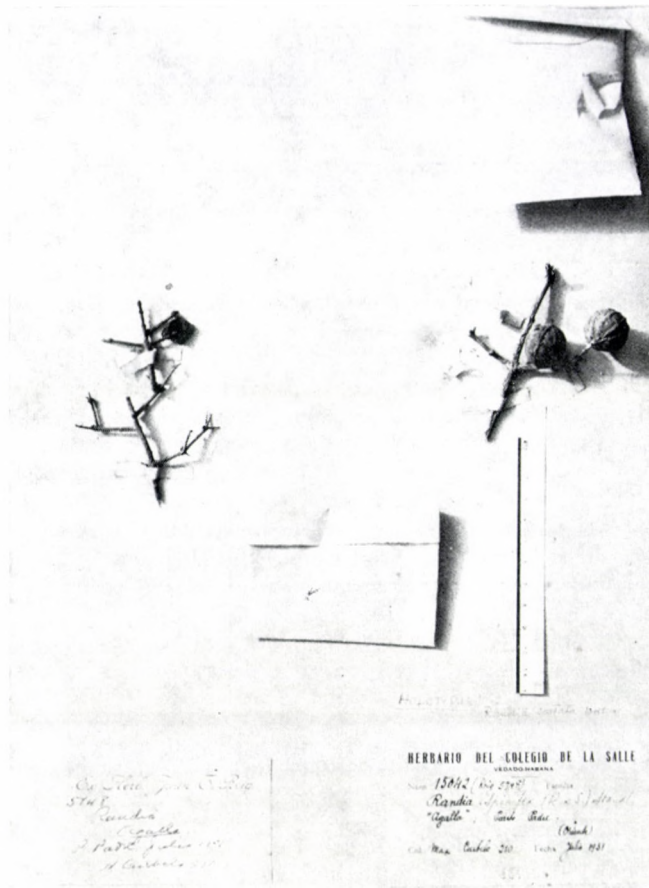
Fig. 1. Holótipo de la *Randia costata* BORHIDI (ROIG 5748 en HAC)

Holotypus: CURBELO 210 HAC; Cuba: Prov. Tunas (Oriente), Puerto Padre. Leg.: M. CURBELO, jul. 1931. Isotypi: ROIG 5748, LS 15042).

Obs.: *Randiae cubanae* BORHIDI affinis, quae a hac specie foliis ellipticis oblongo-obovatis, 1—2 cm longis et 6—12 mm latis, in sicco nigris, chartaceis atque fructibus non costatis differt.

Arbusto ramoso, espinoso. Ramas adultas blancuzcas, cilindráceas, estriadas, glabras, las laterales de 4—6 cm de largo, trifurcadas en el ápice y terminadas en espinas de hasta 1.5 cm de largo. Hojas obovadas, con pecíolo de 1—3 mm de largo o subnulo, redondeadas u obtusas en el ápice, largamente atenuada en la base, de 1.5—3 cm de largo y de 0.9—2.2 cm de ancho; el nervio medio prominente, los laterales 3—5 pares ligeramente prominulos en ambas caras, anastomosados y unidos antes del margen del envés; el limbo brillante en el haz, pálido en el envés, glabro en ambas caras, membranáceo, muy caedizo, el margen plano, entero. Flor desconocido. Fruto sentado, globoso, ligeramente (5—)10-costillado, lenticelado,

de 2—2.5 cm de largo y de 2 cm de ancho, 2-locular; pericarpio grueso; semillas numerosas en cada celda, endospermio óseo.

Endémico local de la costa Norte de la Provincia Tunas. La espécie es conocida solamente de la colección tipica.

4. Randia cubana Borhidi sp. nova

Frutex spinosus, valde ramosus, usque ad 3—4 m altus. Rami hornotini adpresse strigosi, brunnei, demum glabri et cinerascentes, apice trifurcato-spinosi, spinis 5—10 mm longis. Stipulae interpetiolares 1 mm longae, annuliformiter connatae, breviter spinoso-apiculatae. Folia elliptica vel oblongo-obovata, 2—3 mm longe petiolata, lamina ipsa 10—20 mm longa et 6—12 mm lata, apice attenuata et plerumque acuta, rariter obtusiuscula, brevissime mucronulata, basi angustata et in petiolum protracta, supra nitida et in sicco nigrescens, subtus opaca et punctis papillosis dense obsitis cinerascens, nervo medio supra tenuiter impresso, subtus valde prominenti, lateralibus utroque latere 4—6, sub angulo 60—70° abeuntibus utrinque leviter prominulis, subtus obsolete anastomosantibus, supra obsolete reticulatis, lamina margine integra, utrinque glabra, chartacea. Flos ignotus. Fructus globosus, sessilis, axillaris, solitarius, dense lepidotus et prominenter lenticellatus, 1.5—2.5 cm in diametro, apice calyce coronatus, lobi calycis 5, subulati, 3—5 mm longi, reflexi.

Holotypus: 32681 HAJB; Cuba; Prov. Pinar del Rio; Bahia Honda, Las Pozas; cuabales al Sureste de Las Pozas. Leg.: A. ARECES, A. ALVAREZ, J. BISSE et H. KÖHLER, 16. oct. 1976. Isotypi: HAC, JE, BE, BP.

Specimina examinata: 21656 HAC; Pinar del Rio; Toscano, Bahia Honda; leg.: ACUÑA y ROIG, 21. oct. 1951. — 15 850 HAC; La Cajálbana, La Palma; leg.: ACUÑA y ALAIN, 3. dec. 1949.

Obs.: *Randiae spinificis* (ROEM. et SCHULT.) STANDL. affinis, quae a specie nostra foliis obovatis vel suborbicularibus, apice rotundatis vel truncatis, 3—12 mm longis, coriaceis, nervis lateralibus supra inconspicuis, subtus utroque latere 2—3 sub angulo 30—40° abeuntibus, lobis calycis 1—2 mm longis, erectis abunde differt.

Arbusto de hasta 3—4 m de alto, espinoso muy ramificado. Ramitas deprimido estrigosas, pardas, luego glabras y grisáceas, trifurcado-espinosas en el, ápice, las espinas de 5—10 mm de largo. Estípulas de 1 mm de largo, connadas en un anillo, brevemente espinoso-apiculadas en el ápice. Hojas elípticas o alargado-obovadas con un pecíolo de 2—3 mm de largo, el limbo de 1—2 cm de largo y 6—12 mm de ancho, estrechadas y mayormente agudas en el ápice, a veces poco obtusas y muy brevemente mucronadas, estrechadas en la base, el haz brillante y negruzco cuando seco, el envés pálido, densamente papiloso, grisáceo; el nervio medio hundido en el haz, bien prominente en el envés, nervios laterales 4—6 pares ligeramente promínulos en ambas caras, el margen entero; el limbo glabro en ambas caras, cartáceo. Flor desconocido. Fruto globoso, solitario, sentado en las axilas, densamente lepidoto y lenticelado, de 1.5—2.5 cm de diámetro, cáliz permanente en el ápice, lóbulos 5, subulados de 3—5 mm de largo, reflejos.

Endémico en los matorrales serpentinosos moderadamente secos (cuabales) de las areas de serpentinas de la provincia Pinar del Rio, entre La Palma y Bahia Honda.
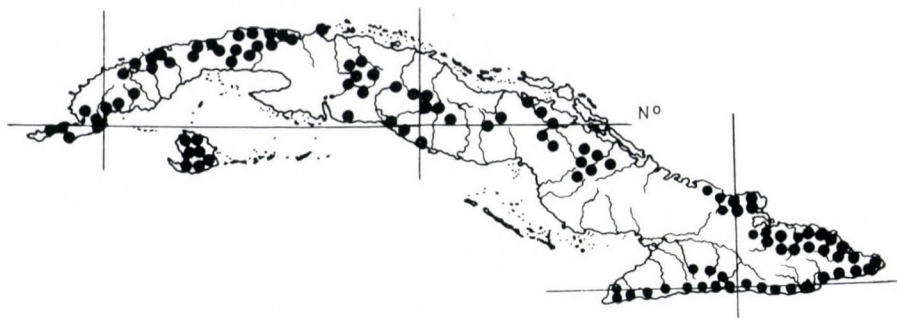
Fig. 2. Distribución geográfica de la *Randia spinifex* (ROEM. et SCHULT.) STANDLEY

5. Randia spinifex (Roem. et Schult.) Standl.

(*Ehretia spinifex* ROEM. et SCHULT. Syst. **4:** 806. 1814; *Gardenia Sagraeana* A. RICH. in Sagra Hist. Cuba **11:** 10. 1850; *Randia Sagraeana* GRISEB. Cat. Pl. Cub. 122. 1866; *Morelosia spinifex* KUNTZE Rev. Gen. 439. 1891; *Genipa Sagraeana* MAZA Anal. Soc. Esp. Hist. Nat. **23:** 288. 1894; *Beureria spinifex* GÜRKE in Engler-Prantl Nat. Pflanzenfam. **4/3a:** 87. 1879; *Scolosanthus Sagraeanus* MILLSP. Field. Mus. Publ. Bot. **2:** 102. 1900; *Basanacantha Sagraeana* URB. Symb. Ant. **5:** 508. 1908; *Basanacantha spinifex* URB. in O. E. SCHULZ Symb. Ant. **7:** 71. 1911; *Randia spinifex* STANDLEY Contr. U. S. Nat. Herb. **20:** 201. 1919)

Arbusto o arbolito de 1—5 m de alto, muy ramoso; las ramas trifurcado-espinosas en el ápice, espinas de 4—15 mm de largo. Estípulas muy pequeñas, gruesas, aovadas, pardas, pelosas por fuera, glabras por dentro. Pecíolo de hasta 1 mm de largo; hojas opuestas o fasciculadas en el ápice de las ramitas, suborbiculares o anchamente obovadas, de 3—15 mm de largo y 3—12 mm de ancho, redondeadas o anchamente atenuadas en la base, redondeadas o truncadas en el ápice, glabras en ambas caras, rígidamente coriáceas; el haz lustroso, negruzco cuando seco, el envés mas pálido; el nervio medio hundido en el haz, prominulo en el envés, los laterales 3—5 pares promínulos en el envés, el margen entero, mayormente recurvo. Flores 1—2, axilares, sésiles, blancas. Lóbulos del cáliz agudos, muy cortos; corola de 4—5 mm de largo, el tubo dos veces mas grandes que el cáliz, garganta glabra, lóbulos anchamente aovados, acuminados y agudos en el ápice; fruto globoso de 2—2.5 cm de diámetro, grisáceo, tuberculado y lenticelado. Semillas numerosas, suborbiculares, de 5—7 mm de diámetro.

Endémico pancubano. Se encuentra en todas las provincias. Vive en los matorrales secos y espinosos sobre serpentinas y calizas, sobre suelos de mocarrero, en matorrales litorales y en la vegetación semidesertica; palmares y sabanas secundarias áridas.

6. Randia acunae Borhidi sp. nova

Frutex ramosissimus spinosus, usque ad 2—3 m altus. Rami hornotini teretes, in sicco nigri, densissime albo-hirsuti, veteriores scaberulo-hirtuli, laterales 5—7 cm longi trifurcati, ramuli in spinas trifurcatas 3—12 mm longas terminati. Stipulae triangulares acutae, 1.5—2 mm longae, purpureae, nitidae, spiniformes, rigide coriaceae, breviter hirsutae. Folia opposita vel plerumque in nodis conferta, obovata vel suborbicularia, 0.2—0.5 mm longe petiolata, 3—8 mm longa et 3—7 mm lata, nervo medio supra impresso, subtus prominenti, lateralibus
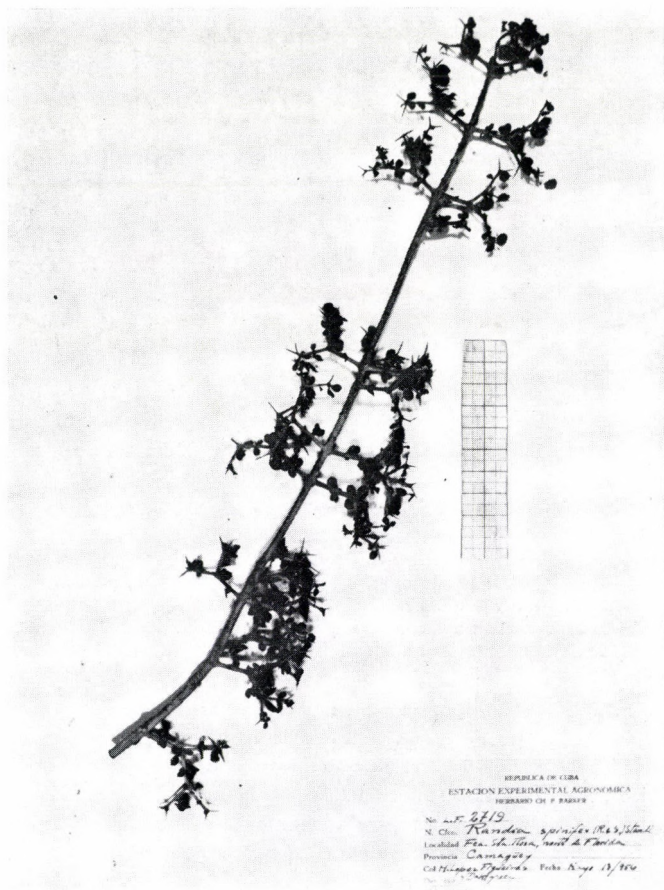
Fig. 3. Isotipo de la *Randia acunae* Borhidi (L. F. 2719 en HAC)

utroque latere 2—4 sub angulo 30—40° abeuntibus supra inconspicuis, subtus prominulis, lamina supra rugulosa, nitidula, nigro-brunnea, subtus pallidior, utrinque densissime breviter hirsuta, margine integra, revoluta, coriacea. Flores 1—3, axillares, sessiles. Calyx 2.5 mm longus, breviter hirsutus, tubus calycis 2 mm longus, lobi 5, triangulares, acuti, usque ad 0.5 mm longi. Corolla infundibuliformis, tubus 5—6 mm longus, 2 mm latus, extus puberulus intus glaber; lobi 5, oblongo-triangulares, vel lanceolati, acuti, 4 mm longi, in alabastro contorti. Stamina 5, sessiles, antherae supra basim dorso affixae, tubo corollae medio adnatae, insertae. Stylus 6 mm longus, apice longe bilobatus. Hypanthium 1.5 mm longum, obovatum, extus hirsutum; ovarium biloculare, ovulis numerosis in quoque loculo.

Holotypus: LF 2719 HAC; Cuba; Prov. Camagüey, Finca Sta Rosa, al Norte de Florida. Leg.: M. López Figueiras et B. E. Dahlgren, 13. Mai, 1956. Isotypi: HAJB, BP.

Specimina examinata: 14 582 HAC. Prov. Camagüey; La Entrada Florida. Leg.: J. Acuña, 20. mart. 1947.

Obs.: Habitu, foliis *Randiae spinificis* (ROEM. et SCHULT.) STANDL. affinis, quae a specie nostra ramulis, foliis floribusque glabris, stipulis viridibus vel luteis glabris, corolla minore clare differt.
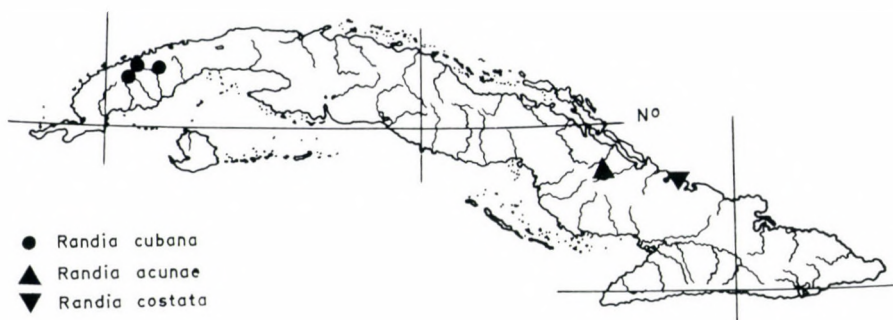
Fig. 4. Distribución geográfica de *Randia costata* BORHIDI, *R. cubana* BORHIDI y de *R. acuna* BORHIDI

Arbusto muy ramoso de 2—3 m de alto. Ramitas cilindráceas, négras cuando secas, densamente hirsutas, las laterales de 5—7 cm de largo. Estípulas triangulares, agudas de 1.5—2 mm de largo, rojizas, brillantes, espinosas, brevemente hirsutas, coriáceas. Hojas opuestas o fasciculadas en los nódulos, pecíolo de hasta 0.2—0.5 mm de largo, el limbo obovado o suborbicular, de 3—8 mm de largo y 3—7 mm de ancho; nervio medio hundido en el haz, prominente en el envés, los laterales 2—4 pares, inconspicuos en el haz, promínulos en el envés, lámina de la hoja plegada y brillante en el haz, perdo-negruzca cuando seca, mas pálida en el envés, densamente hirsuta con pelos cortos en ambas caras, coriácea; el margen entero, revoluto. Flores 1—3 en las axilas, sentadas. Cáliz de 2.5 mm de largo, brevemente hirsuto, el tubo de 2 mm, los lóbulos 5, triangulares, agudos de 0.5 mm de largo. Corola embudada, el tubo de 5—6 mm de largo, pubérula por fuera, glabra por dentro; lóbulos 5, alargado-triangulares o lanceoladas, agudas, de 4 mm de largo, cortortos en el botón. Estambres 5, sentadas, anteras dorsifijas sobre la base, en la mitad del tubo adnatas, insertas. Estilo de 6 mm de largo, bilobulado. Ovario obovado, de 1.5 mm de largo, hirsuto por fuera, bilocular, ovulos numerosos en cada celda.

Endémico local de los suelos de mocarrero de la provincia Camagüey, cerca de Florida

SHAFEROCHARIS URB.
Symb. Ant. 7: 412, 1912.

Arbustos o arbolitos resinosos glabros o hirsutos. Estípulas coriáceas, triangulares, cuspidadas o aristadas, connadas en la base. Hojas opuestas, coriáceas, resinosas, Inflorescencias axilares, pedunculadas, cimoso-capitadas, pauci-multifloras. Flores pequeñas, sésiles, brácteas involucrales (2—)—4 de distinto tamaño por pares, enteras o trilobuladas, tubo del cáliz oblongo-elíptico u oblongo-obovado, lateralmente comprimido, peloso a velloso, lóbulos 4, a veces 5—6, cortos. Corola anchamente embudada acampanada, tubo cilíndrico y estrecho en la base, abruptamente ensanchado arriba, 4-angular, glabro por dentro, lóbulos 4, triangulares, agudos, valvares en el botón, recurvos. Estambres 4, insertos arriba de la base del

tubo de la corola, filamentos filiformes, glabros, connados por pares y adnatos a la base de tubo; anteras aovado-oblongas, dorsífijas, exertas; ovario 2-locular, estilo filiforme; ovulos oblongos, solitarios, péndulos del ápice de la celda; fruto en cápsula oval u obovado, peloso a velloso, comprimido lateralmente, 2-locular; exocarpio delgado, se abre con 2 valvas septicidamente; semillas linear-lanceoladas, arilosas en la base.

Género endémico cubano con tres espécies, anteriormente conocido como monotipico, estrechamente relacionado al género antillano *Phialanthus* Griseb. Las diferencias esenciales existentes entre los dos géneros estan presentadas en la tabla 1.

Espécie típica: *Shaferocharis cubensis* Urb.

Tabla 1

	Phialanthus	*Shaferocharis*
Estipulas	connadas en anillo truncado	connadas en la base, lobuladas
Involucro	connado	formado por brácteas libres
Inflorescencia	sentada	pedunculada
Lóbulos del cáliz	grandes, planos, redondeados a espatulados en el ápice	pequeños, plegados, cuculados en el ápice
Tubo de corola	embudado cilíndrico	4-angular arriba
Fruto	drupáceo	cápsula
Dehiscencia	no dehiscente	septicida

Clave para las espécies:

1 a Hojas de 1—2 cm de largo, inflorescencia 3-flora capítulo subsentado, pedúnculo de 0.1—0.4 cm de largo . . . . **1. S. cubensis Urb.**

b Hojas mas grandes, de 3—6 cm de largo, capítulos multífloros con pedúnculos de 2—5 cm de largo 2

2 a **Pecíolo y hojas pubescentes en el envés, capítulo de 1.5—2 cm de ancho, hipantio y corola vellosos por fuera** . . . . . **3. S. villosa Borhidi et Bisse**

b **Pecíolos y hojas glabros, capítulo de 7—11 mm de ancho, hipantio corto-peloso, corola glabra** . . . . **2. S. multiflora Borhidi et Muñiz**

1. Shaferocharis cubensis Urb.

Symb. Ant. **7:** 413, 1912

Arbusto de 1—2 m de alto, ramitas pelositas, resinosas, negruzcas cuando secas, densamente hojosas en el ápice, las adultas grisáceas, transversalmente estriadas. Estípulas coriáceas, persistentes, brevemente pelosas, rigidas, de 4—5 mm de largo, algo connadas en la base. Pecíolo de 1—1.5 mm de largo; hojas aovadas, oval-elípticas o elíptico-oblongas, de 1—2 cm de largo y 0.4—1 cm de ancho, obtusas o agudas en el ápice, obtusas a brevemente redondeadas

Fig. 5. Holótipo del *Shaferocharis multiflora* BORHIDI et MUÑIZ (HAC 27122)

en la base, el limbo resinoso, rígidamente coriáceo, escabroso-peloso en el haz y a lo largo del nervio medio del envés, brillante en ambas caras, el margen poco recurvo. Inflorescencias axilares, cimoso-capitadas, mayormente 3-floras, pedúnculos de 1—4 mm de largo, brácteas involucrales 2—4, de 4—7 mm de largo. Tubo del cáliz oblongo, lateralmente comprimido, brevemente peloso, lóbulos 5, raramente 4 o 6, lanceolados o lineales, de 1—1.3 mm de largo; corola de 4 mm de largo, cartáceo, lóbulos 4, triangulares o aovado-triangulares, valvares en el botón. Estambres 4, filamentos de 2.5 mm de largo, insertos en la base del tubo de corola y brevemente adnatos, poco pelosos; anteras de 2 mm de largo, lineal-aovadas u oblongo-lineales, obtusas en el ápice. Cápsula de 3 mm de largo, lateralmente comprimido, brevemente peloso.

Endémico local de los matorrales montanos de serpentinas de El Toldo (Sierra de Moa) entre 600—1000 m de altura.

2. Shaferocharis multiflora Borhidi et Muñiz

Acta Bot. Acad. Sci. Hung. **17:** 33, 1971

Arbusto resinoso de 3—4 m de alto; ramitas obtusamente 4-angulares, pardas, densamente pubérulas y glandulosas por glándulas sentadas, internodios de 6—12 mm de largo. Estípulas interpeciolares triangulares o aovado-triangulares, de 2—3 mm de largo, peloso con una costa media dorsal, terminado en una arista de 2—4 mm de largo en el ápice, libres o brevemente connadas en la base. Pecíolo de 2—3 mm de largo; hojas opuestas, oblongo-oblanceoladas, de 4—6 cm de largo, y 0.7—1.6 cm de ancho, largamente cuneadas en la base, brevemente acuminada en el ápice, terminada en un mucrón engrosado, mayormente reflejo, el margen entero, plano o algo recurvo, el limbo coriáceo, verde en el haz, olivo-verde a amarillento en el envés, resinoso en ambas caras; nervio medio hundido en el haz, evanido hacía el ápice, prominente en el envés; laterales numerosos, poco prominulos en el haz, inconspicuos en el envés. Inflorescencias axilares, largamente pedunculadas, capitadas, 6—20-floras, resinosas. Pedúnculos de 2—5 cm de largo, angulosos, pubérulos, engrosados en el

Fig. 6. Shaferocharis multiflora BORHIDI et MUÑIZ, ramas e inflorescencias
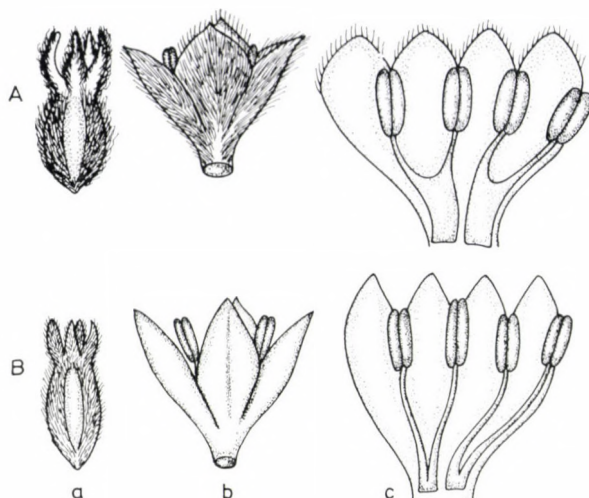
Fig. 7. Estructura de las flores de *Shaferocharis villosa* BORHIDI et BISSE (A) y de *S. multiflora* BORHIDI et MUÑIZ (B). *a)* cáliz, *b)* corola, *c)* sección de la corola

ápice. Involucro formado por 4 brácteas aovadas, agudas, coriáceas, caedizas; las exteriores de 5—8 mm, las interiores de 2—4 mm de largo, el nervio medio inconspicuo en el haz, hundido en el envés. Flores sentadas, pequeñas. Tubo del cáliz lateralmente comprimido, pubérulo, lóbulos 4, triangulares, comprimidos, cuculados en el ápice. Corola amarilla de 4—5 mm de largo, el tubo cilíndrico abruptamente estrechado hacía la base, 4-anguloso y muy ensanchado arriba, glabro en ambas caras; lóbulos 4, de igual largo del tubo, aovado-triangulares, valvares en el botón, engrosados en el margen, reflejos. Estambres 4, insertos sobre la base del tubo, filamentos filiformes, glabros, anteras aovado-oblongas, dorsífijas, poco exertas. Disco carnoso brevemente cónico bipartido en el fruto. Ovario bilocular, estilo filiforme, mas largo que los estambres, globoso en el ápice. Cápsula pequeña, de 2—3 mm de largo, lateralmente comprimido, densamente pubescente, abriéndose septicidamente con dos valvas. Semillas de 1—1.5 mm de largo, lineal-oblongas, pardo-negruzcas, rugoso-escabrídulas, engordadas en la inserción con un apéndice blanca arilosa.

Endémico local de los matorrales siempreverdes serpentinosos de la zona del Rio Yamanigüey, entre las Sierras de Moa e Ibéria en la costa Norte de Cuba oriental (Prov. Guantánamo). Florece en enero-marzo.

3. Shaferocharis villosa Borhidi et Bisse sp. nova

Frutex vel arbor parva, 3—6 m alta resiniflua, rami veteriores teretes, cinerascentes, hornotini quoque teretes, leviter striolati, brunnei, pilis patentibus ferrugineis vel albis dense hirsuti; internodiis 5—10 mm longis. Stipulae interpetiolares oblongo-triangulares vel oblongo-lanceolatae, 5—6 mm longae, basi usque ad 2 mm longe connatae, superne trilobatae, dorso hirsutae, lobis subulatis suffultae, lobus centralis longe aristatus, 4—5 mm longus, laterales 1—2 mm longi. Folia opposita, 5—10 mm longe petiolata, petiolis dense hirsutis suffulta, oblanceolata vel lineari-lanceolata, 6—9 cm longa et 1.2—3 cm lata, basi longe cuneata,

apice breviter apiculata et acuta, brevissime mucronulata, nervo medio supra in sulco prominulo, subtus inferne valde prominenti, laterales utroque latere 11—15, in angulo 80° abeuntibus, supra levissime prominulis, subtus tenuiter impressis vel utrinque obsoletis, lamina utrinque opaca, subtus valde pallidior, supra resinosa, pilosa vel glabrescens, subtus in nervo medio et ad marginem dense hirsuto-puberula, ceterum sparse pilosa, margine integra, plana vel revoluta, coriacea. Inflorescentiae axillares, longe pedunculatae, capitatae, multiflorae, 20—35-florae, resinosae, pubescentes. Pedunculi 2—5 cm longi, angulati, superne incrassati, puberuli, Involucrum ex euphyllis 4, deciduis forma valde aliena confertum. Euphylla involucralia externa oblongo-ovata, 8—11 mm longa, coriacea, interna 2 oblanceolata, apice acuta, 3—5 mm longa, villosula. Flores sessiles parvi. Calycis tubus 2—2.5 mm longus, obovatus, lateraliter compressus, hirsutus vel villosus, lobi 4 e basi triangulari lineari-subulati, compressi, apice cucullati, 1.2—1.6 mm longi, longe pilosi. Corolla 3.5 mm longa, flava, resinosa et extus longe villosula, intus glabra, tubus 2.5 mm longus, inferne cylindraceus, superne 4-angulatus et valde dilatatus, lobi 4 valvati late triangulares, 1.5 mm longi et 1.5—2 mm lati. Stamina 4, filamenta basi per pares 0.6—0.8 mm longe connata et ad tubum corollae adnata, pars libera filamentorum cca 1 mm longa, glabra, antherae oblongo-obovatae, supra basim dorsifixaee
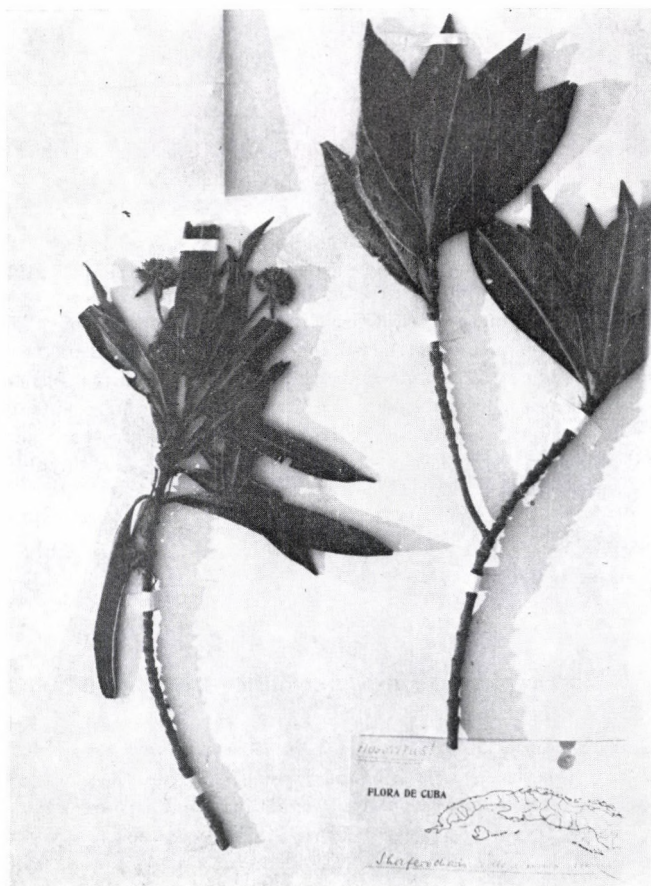
Fig. 8. Shaferocharis villosa Borhidi et Bisse, holótipo

breviter exsertae, 1—1.5 mm longae. Ovarium oblongo-obovatum, biloculare, loculi 1-ovulati. Ovula lineari-oblonga, basi arillosa.

Fructus obovatus, lateraliter compressus, 5 mm longus, levissime costatus, villosus, bilocularis, septicide apertus; semina lineari-oblonga, 1.5—2 mm longa, basi arillosa.

Holotypus: HAJB 16189; Cuba; Prov. Guantánamo-Baracoa, en charrascales humedos del Rio Maravi. Leg.: J. Bisse y B. Kitanov marzo 1970. Isotypi: JE, SOF.

Arbusto o arbolito de 3—6 mm de alto, resinoso; ramitas cilíndricas, grisáceas, ligeramente estriadas, de pelos extendidos feruginosos o blancos densamente hirsutas; internodios de 5—10 mm de largo. Estípulas interpeciolares oblongo-triangulares o lanceolado-oblongas, de 5—6 mm de largo, en la base connadas en un anillo de 2 mm de ancho, 3-lobuladas arriba, lóbulos subulados, el central de 4—5 mm de largo, aristulado en el ápice, los laterales de 1—2 mm de largo. Pecíolo de 5—10 mm de largo, densamente hirsuto; hojas oblanceoladas o lineal-lanceoladas, de 6—9 cm de largo y 1.2—3 cm de ancho, brevemente apiculadas, agudas y muy brevemente mucronadas en el ápice, largamente cuneadas en la base; nervio medio promínulo en el surco del haz, muy prominente en el envés, los laterales 11—15 pares ligeramente prominulos en el haz, finalmente hundidos en el envés, poco conspicuos en ambas caras; el limbo resinoso y peloso a glabrascente en el haz, hírtulo-pubérulo en el nervio medio y en el margen del envés; el limbo peloso en el envés, el margen entero, plano revoluto, rígidamente coriáceo. Inflorescencias axilares, capitadas, largamente pedunculadas, multífloras, con 20—35 flores, resinosas, pubérulas. Pedúnculos de 2—5 cm de largo, angulosos, engrosados arriba, pubérulos. Involucro formado de 4 brácteas muy desiguales por pares, caedizas. Brácteas involucrales exteriores oblongo-aovadas, coriáceas, de 8—11 mm de largo, las interiores oblanceoladas, agudas en el ápice, de 3—5 mm de largo, vellosas. Flores sentadas, pequeñas. Tubo del cáliz de 2—2.5 mm de largo, obovado, lateralmente comprimido, hirsuto o velloso; lóbulos 4 triangular-subulados, comprimidos, de 1.2—1.6 mm de largo, cuculados en el ápice, largamente pelosos. Corola de 3.5 mm de largo, amarilla, resinosa, largamente vellosa por fuera, glabra por dentro; tubo de 2.5 mm de largo, cilíndrico y estrecho en la base, 4-anguloso y muy ensanchado hacia arriba, lóbulos 4, valvares, anchamente triangulares, de 1—1.5 mm
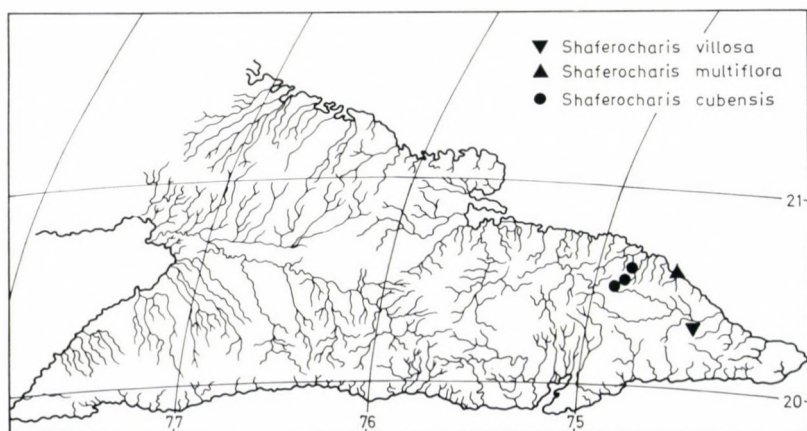
Fig. 9. Distribución geográfica de *Shaferocharis cubensis* Urb., *S. multiflora* Borhidi et Muñiz y *S. villosa* Borhidi et Bisse

de largo y de 1.5—2 mm de ancho. Estambres 4, filamentos connados por pares en la base y adnatos al tubo de la corola, parte libre de los filamentos glabra, anteras oblongo-obovadas, dorsífijas, de 1—1 5 mm de largo, exertas. Ovario oblongo-obovado, bilocular, celdas 1-ovuladas. Óvulos lineal-oblongos, arilosos. Cápsula obovada, lateralmente comprimida, de 5 mm de largo, ligeramente acostillada, vellosa, bilocular, septicidamente dehiscente. Semillas lineari-oblongas de 1.5—2 mm de largo.

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Acta Botanica Academiae Scientiarum Hungaricae, Tomus 27 (1—2), pp. 37—41 (1981)

APPLICATION OF CROSS-CORRELATIONS BETWEEN TIME SERIES AND CROSS-SECTIONAL DATA IN PRODUCTION ANALYSES

By

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(Recived: 3 June, 1980)

Turnover, i.e. the rate and time for the plant material to pass over from one compartment to the other (green fractions, standing dead, litter) has an important part to play in the nutrient cycle of plant communites. In the study, the time taken by standing dead to pass to the litter phase, and the rate constant, have been examined with a new method. A positive correlation of cross-sectional data is suitable not only for determining the delay constant but also for estimating the rate constant of the process litter forming. It has been stated that, in the *Artemisio-Festucetum pseudovinae* association, standing dead takes 2—5 months to get into the litter phase. The two months obtained from the cross-correlation of time-series does not reflect the whole process which is considerable even in the fifth month. The value of the rate constant (k) is near to 0.0036 (l/month).

Introduction

In the turnover of natural plant associations, litter plays a vital part. Litter is an important compartment, returning nutritive materials, not only in forests but also in meadows. In plant production analyses, three above-ground compartments are distinguished, viz. living green fractions; standing dead non-living parts and litter. Living green fractions and standing dead participate in litter formation. The formation and decomposition of litter is a slow process (Olson, 1963); the determination of its delay constant can be correlated with turnover time.

In the present study we have tried to ascertain the role of standing dead in litter formation by looking at the correlation between it and litter. For the estimation of the delay constant the method of cross-correlation analysis has been used.

Material and method

In the framework of the IBP program of Hungary, the standing dead and litter weights were measured in five repetitions in April, June and September every year between 1967—1971, in the *Artemisio-Festucetum pseudovinae* association at Újszentmargita. The data obtained have been analysed in the present paper (Précsényi 1975).

In applying the method of cross-correlation, the values of two time series shifted in relation to one another are used in a correlation analyses as:

$$r_{xy}(t_1, t_2) = \frac{\text{cov}\,(X_{t1} Y_{t2})}{\sqrt{\text{var}\, X_{t1}}\ \sqrt{\text{var}\, Y_{t2}}} \qquad (1)$$

This method of cross-correlation analysis has already been used on a large scale in the correlation analysis of biological and physical processes (e.g. DAVIES 1971, BRANDT 1976 and CHATFIELD 1978).

In application of cross-correlation only average values of cross-sectional data concerning every sampling time are taken into consideration, so that every sampling time each pair of data is formed.

From econometric examinations it is however well-known (e.g. GRANGER and NEWBOLD 1978) that regression and correlation analyses applied to time series — cross-correlation analyses included — may become unreliable due to the autocorrelation of the residuals. In other words, the constancy of the cross-correlation coefficient in the time intervals examined is highly questionable.

If we suppose that the cross-correlation coefficient depends not only on the selection of sampling time t_1 and t_2 but also on the period of time,[1] then the former definition can reasonably be re-written in the following form:

$$r_{xy}^{t_1,t_2} = \frac{S_{xy}^{t1,t2}}{\sqrt{S_x^{t1}}\sqrt{S_y^{t2}}} \quad (2)$$

where X^{t1} is a cross-sectional data series of variable X for sampling time t_1, and S_x^{t1} is it variance;

Y^{t2} is a cross-sectional data series of variable Y for sampling time t_2, and S_y^{t1} is its variance;

$S_{xy}^{t1,t2}$ is the covariance of the cross-sectional data series belonging to sampling times t_1 and t_2.

Thus, in calculating the cross-correlation of the cross-sectional data, at each sampling time t_i we have not individual data pairs but two vectors of observations, as is indicated in Fig. 1.

In the case of a time lag $l = 1$, the dotted line indicates the values belonging together and drawn into the calculation of correlation (Fig. 1). In another case, the individual observation values Y_1^1, Y_1^2, etc. would also be indicated in the upper part of Fig. 1. Naturally, the demonstration of a process with a time lag greater than 1, and of a slower effect, can be carried out in the same way, but it will have $n - l > 1$, where n indicates the number of cross-sectional data series.[2]

In calculating the cross-correlation of cross-sectional data, the fact that no sampling took place at different points of time at the same place should be taken into consideration. The use of data pairs drawn into the correlation calculation is justified by the relatively homogeneous state of the association.

The change in the cross-correlation coefficient provides an answer also related to the rate of delay constant. This is definable by the time lag belonging to the closest correlation.

In a cross-correlation analysis of the cross-sectional data, the time series of the correlation coefficient can also provide useful information. The derivative of the correlation coefficients by time represents the rate constant of the process, which is analogous to the characteristic computable by means of compartment analyses (EŐRY 1980).

Results and evaluation

On the basis of the cross-correlation coefficients calculated from cross-sectional data of the test series covering five years (standing dead and litter) it can be stated that delay constant of the process is 5 months (Fig. 2).

[1] Naturally, in a sense that it is not constant in the finite time intervals beginning with t_1 and t_2.

[2] Here is meant a process of slower effect than the shortest time taken between the individual samplings. If the samplings take place essentially more frequently than the delay constant of the process, the latter can be calculated more accurately with the method.
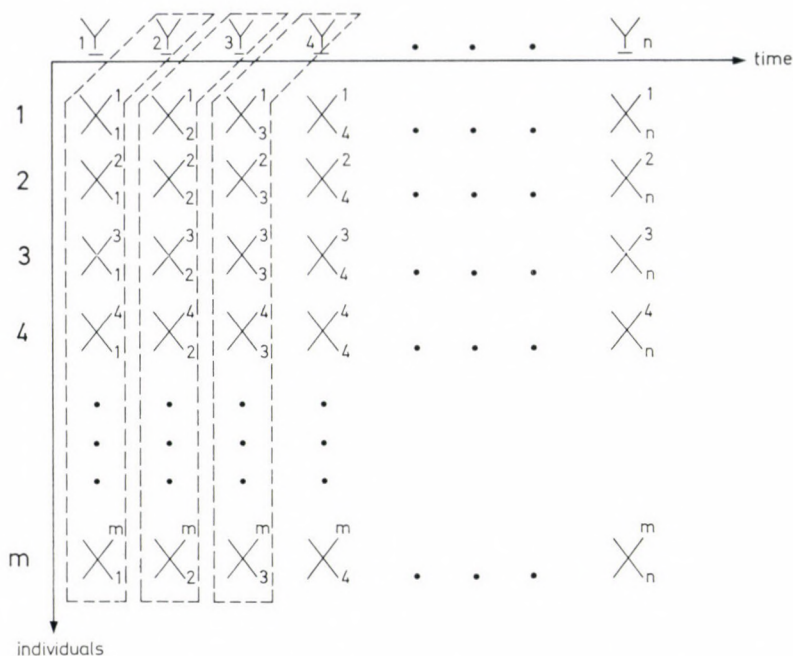
Fig. 1. Position of the data vectors in calculating the cross-correlation of the cross-sectional data in the case of a time lag $l = 1$
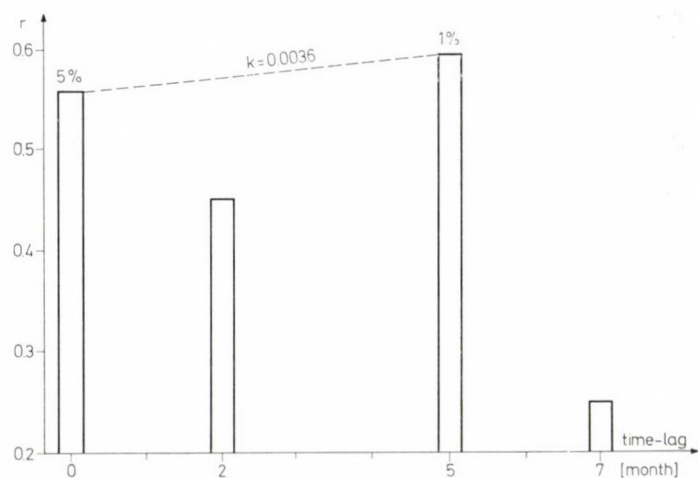
Fig. 2. Cross-correlation coefficients calculated from cross-sectional data in function of the time lag. — r = correlation coefficient; % = level of significance

In cross-correlation coefficients, the maximum value was obtained at the two-month time lag. In this way, the calculation provides a delay constant of two months for the process (Fig. 3).

The rate constant of the process is very small: 0.0036 (1/month).

In a comparison between the two kinds of results the question arises: which one of the delay constants is more probable, that of five months or that of two months?

Knowing the association and on the basis of the results given above, it can be inferred that in the association examined the litter formation takes place in two phases. In the first phase, a certain percentage of the green fraction transforms into litter quickly. This process takes place at the beginning of the vegetation period quickly. On this occasion, the annuals (e.g. *Cerastium anomalum*, *Galium pedemontanum*, etc.), and the green fractions geophyta enduring the unfavourable summer period in the ground (e.g. *Ornithogalum gussonei*) got into the litter. In the second phase, the green fractions first become standing dead, and from the latter the litter forms. In perennials the standing dead get into the litter at this phase (e.g. the fertile shoots of *Festuca pseudovina*), and very often as early as just after surviving the winter (e.g. the shoots of *Limonium gmelini*).

The above results are supported by the statement of PRÉCSÉNYI and MOLNÁR (1975) according to which — in the same area — the turnover rate of the important macroelements related to the vegetation period is more or less 50—60% of the latter (that is more less 200 days). Presumably, there is a correlation between the turnover of macroelements and that of the whole matter. Since the above authors took into consideration also the green frac-
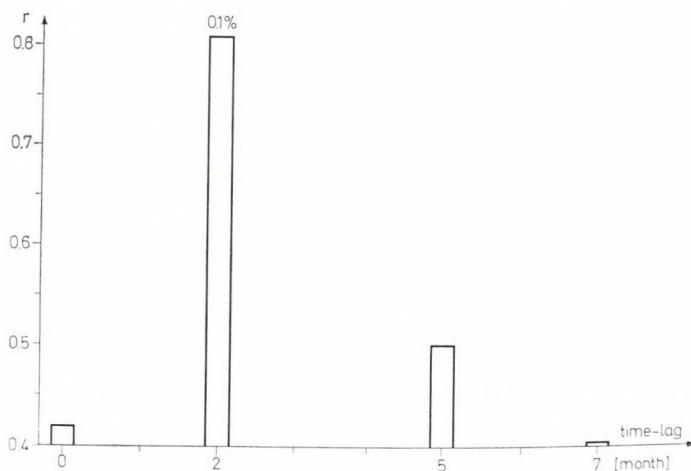
Fig. 3. Cross-correlation coefficients of the time series data in function of the time lag. — r = correlation coefficient- % = level of significance

tion in their examinations, from the value obtained by us must subtract only the turnover time of green fraction into standing dead. This on the average amounts to 30 days, that is, the turnover time in relation to standing dead and litter is 200—30=170 days, which can be taken as nearly five months.

From what has been said above the following information can be drawn: a great part of the process of litter formation takes place as early as in the first month. This is understandable since a certain percentage of the green fractions turns into litter immediately. In the months following this, the process is very slow (this is indicated by the small value of the rate constant), and lasts for five months.

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Acta Botanica Academiae Scientiarum Hungaricae, Tomus 27 (1—2), pp. 43—52 (1981)

ELEMENT COMPOSITION OF THE LEAVES OF SOME DECIDUOUS TREES AND THE BIOLOGICAL INDICATION OF HEAVY METALS IN AN URBAN-INDUSTRIAL ENVIRONMENT

By

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(Received: 10 December, 1979)

The element content (Ca, Mg, K, Na, P, Fe, Sr, Mn, Pb, Zn, Cu) of *Robinia pseudacacia*, *Acer platanoides* and *Tilia tomentosa* was examined in an industrial-urban (Budapest) and in a rural (Vácrátót) environment. Under the effect of air pollution, the leaves of tree species accumulate the various oligo-elements, heavy metals in a quantity 1.2—9 times higher in the industrial-urban environment than that in a rural environment. *Robinia pseudacacia* is a biological indicator of Mn, Pb, while *Tilia tomentosa* in that of Sr, Zn and Pb. A map of oligo-element and heavy metal load in one of the industrial districts in Budapest has been prepared on the basis of the element accumulation in the leaves of monitor species.

Introduction

In big cities and in the industrial regions an increasing danger has emerged in that the elements toxic to human health conditions occur in ever greater quantities in the air and in the soil. In Budapest, for example, with the depositing dust the following quantity of metal falls to 1 m^2 maximally: Cu, 5.7 mg/month; Ni, 1.0 mg/month; Zn, 26.3 mg/month (GAJDOS et al. 1978).

The accumulation of the various metals can be detected in all the living organisms of big cities today.

Certain tree species, as bio-accumulators are able to accumulate certain elements and heavy metals in a greater quantity (as against that in the control area) without danger to their organisms reducing thereby the toxic effect. The elements accumulated in leaves can be removed with the autumn litter from the environment of big cities.

The tree species the heavy metal content of which increases proportionally with the extent of load can be used as monitor plants (biological indicators).

The aim of the study

In one of the districts, abundant industrial factores (District No. IV, named Újpest), the element accumulation, biological indication of heavy-metal load of the district was to be determined, surveyed, with regard to the three tree species (*Robinia pseudoacacia*, *Acer platanoides*, *Tilia tomentosa*) most frequently occurring there.
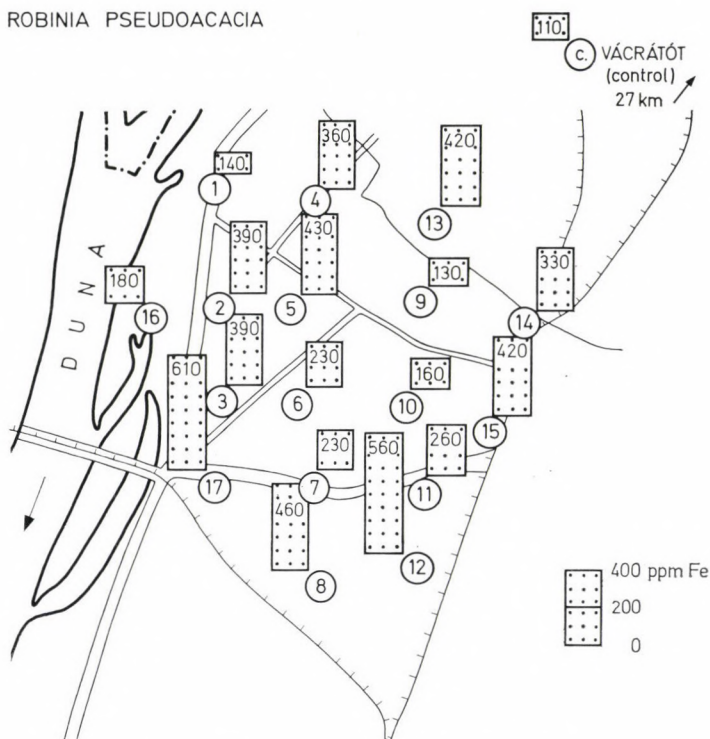
Fig. 1. Fe-content in *Robinia pseudacacia* leaves

We marked 17 sampling areas (in a square net distribution) in the district (see Figs 1—6). *Robinia pseudacacia* occurred in all the 17 areas; *Acer platanoides* in 12; *Tilia tomentosa* in 7 sampling areas. The dendrological collection of the Botanical Garden of the Research Institute for Botany of the Hungarian Academy of Sciences in Vácrátót served as a control. The leaves were collected on August 30—31, 1978.

The following elements were determined in the leaves of the trees: Ca, Mg, K, Na, P, Fe, Sr, Mn, Pb, Zn, Cu.

Results

1. *The element content of the tree leaves*

As regards the poly-element (Ca, Mg, K, Na, P) content in the leaves of the three tree species there were only smaller differences in the samples taken in Újpest resp. in the control area (cf. Tables 1, 2, and 3). The poly-elements are in a slightly higher quantity in the tree leaves, with the exception of *Robinia pseudacacia*, occurring in the industrial-urban region.

Table 1

Chemical composition of Robinia pseudacacia leaves
(average values and significant differences — P = 5%)

Sampling area	Sample No.	Ca	Mg	K	Na	P	Fe	Sr	Mn	Pb	Zn	Cu
		%					ppm					
1.	184—188	1.44	0.20	1.14	0.05	0.17	140	44	39	15	35	9
2.	199—203	2.50	0.31	1.36	0.12	0.08	390	178	34	19	132	15
3.	214—218	1.94	0.23	1.78	0.10	0.07	390	57	39	19	53	11
4.	234—238	1.72	0.24	2.16	0.11	0.06	360	60	22	20	45	11
5.	219—223	1.90	0.19	1.40	0.10	0.05	430	53	39	15	48	9
6.	344—348	2.74	0.26	2.16	0.10	0.11	230	109	42	16	32	9
7.	329—333	1.86	0.23	1.85	0.08	0.11	230	62	31	29	30	9
8.	319—323	2.06	0.28	1.82	0.12	0.10	460	95	43	21	82	13
9.	259—263	2.50	0.23	1.12	0.09	0.07	130	63	36	10	30	8
10.	359—363	2.82	0.30	2.03	0.08	0.14	160	81	41	17	44	9
11.	294—298	1.73	0.32	1.31	0.06	0.09	260	70	29	21	25	10
12.	299—303	2.00	0.26	1.36	0.09	0.09	560	82	34	27	53	12
13.	249—253	1.86	0.35	1.06	0.07	0.06	420	74	34	11	33	10
14.	269—273	2.10	0.47	0.96	0.10	0.05	330	57	33	13	35	10
15.	284—288	2.44	0.28	1.09	0.06	0.09	420	72	31	18	28	10
16.	204—208	1.96	0.25	0.86	0.09	0.04	180	79	21	12	92	11
17.	324—328	2.23	0.27	1.84	0.07	0.10	610	79	45	40	66	14
Vácrátót	369—373	2.48	0.31	1.22	0.09	0.11	110	65	45	14	31	7
SD		0.69	—	0.50	—	0.02	200	10	16	12	45	3

Certain oligo-elements (Fe, Sr, Mn, Pb, Zn, Cu) in the leaves can be detected in a quantity 1.2—9 times higher in the industrial environment.

The quantitative order of the element content of the leaves changes — even though to a smaller extent — in the environment of big cities:

Robinia	nv*	Ca > K > Mg > Na > P > Fe > Sr > Zn > Mn > Pb > Cu
pseudacacia	k**	Ca > K > Mg > P > Na > Fe > Sr > Mn > Zn > Pb > Cu
Acer	nv	Ca > K > Mg > Na > P > Mn > Fe > Sr > Cu > Zn > Pb
platanoides	k	Ca > K > Mg > P > Na > Fe > Mn > Sr > Zn > Pb Cu
Tilia	nv	Ca > K > Mg > Na > P > Fe > Sr > Zn > Mn > Pb > Cu
tomentosa	k	Ca > K > Mg > P > Na > Fe > Sr > Zn > Mn > Pb > Cu

* nv: in big cities; ** k: in control areas

Table 2

Chemical composition of Acer platanoides leaves
(average values and significant differences P = 5%)

Sampling area	Sample No.	Ca	Mg	K	Na	P	Fe	Sr	Mn	Pb	Zn	Cu
		%					ppm					
1.	194—198	1.36	0.19	1.08	0.07	0.07	250	43	580	14	35	7
2.	209—213	1.42	0.22	1.10	0.14	0.05	430	41	324	13	31	7
4.	239—243	2.22	0.40	1.04	0.06	0.05	170	74	606	11	31	6
5.	224—228	1.60	0.19	1.06	0.08	0.03	200	32	386	12	43	9
6.	339—343	2.40	0.33	1.39	0.08	0.09	190	90	41	12	35	7
7.	334—338	1.22	0.22	1.52	0.06	0.08	240	42	32	17	26	7
8.	314—318	1.88	0.29	1.06	0.04	0.09	270	85	94	15	40	9
9.	254—258	1.54	0.28	1.14	0.08	0.06	230	35	530	12	28	8
10.	354—358	2.25	0.33	0.88	0.03	0.11	150	65	134	12	29	5
11.	289—293	1.62	0.33	1.15	0.05	0.05	330	55	93	19	46	9
12.	304—308	2.12	0.30	0.97	0.06	0.07	270	64	42	19	29	8
15.	279—283	1.62	0.28	1.54	0.06	0.06	310	51	394	14	47	12
Vácrátót	364—368	1.65	0.36	0.99	0.06	0.11	90	48	60	9	39	8
SD		0.38	0.08	0.40	0.04	0.02	80	14	143	—	—	4.4

Table 3

Chemical composition of Tilia tomentosa leaves
(average values and significant differences P = 5%)

Sampling area	Sample No.	Ca	Mg	K	Na	P	Fe	Sr	Mn	Pb	Zn	Cu
		%					ppm					
1.	189—193	2.02	0.49	1.08	0.09	0.04	190	74	38	17	35	8
4.	245—248	2.62	0.58	1.44	0.08	0.06	240	103	34	13	48	10
5.	229—233	2.32	0.61	1.28	0.34	0.04	320	124	41	17	44	10
9.	264—268	2.26	0.42	2.70	0.09	0.04	260	149	29	12	43	9
10.	349—353	2.78	0.57	1.90	0.09	0.10	200	97	38	18	65	14
12.	309—313	2.30	0.55	1.20	0.09	0.09	430	117	35	30	40	13
15.	274—273	2.52	0.80	1.38	0.07	0.05	370	57	42	16	130	10
Vácrátót	374—378	1.96	0.55	1.62	0.11	0.13	240	71	30	14	46	11
SD		—	0.20	—	0.11	0.02	120	28	—	5	—	3
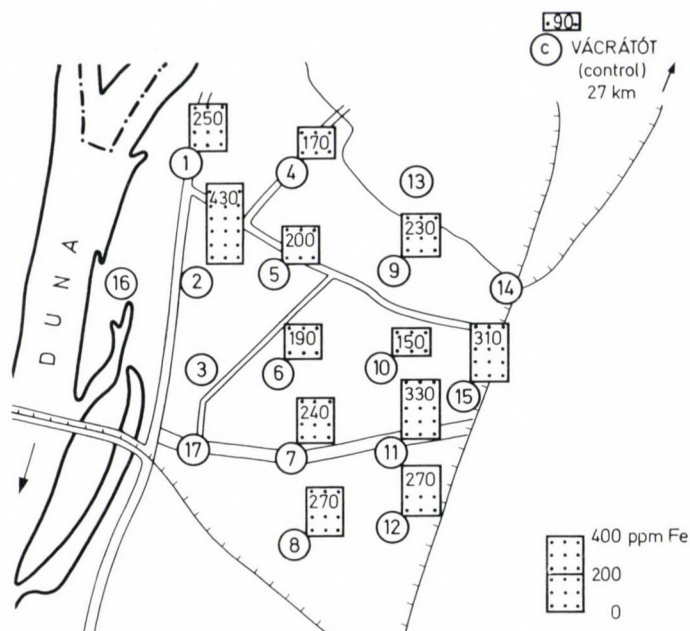
Fig. 2. Fe-content of *Acer platanoides* leaves

In all the three tree species, in the industrial-urban environment, Na is substituted (in the quantitative order) by phosphorus. As a result of the reads being salted, the Na content of the leaves increases — even if only to a small extent. It is under the effect of the industrial environment that in the quantitative order of the elements, the place of Zn in the leaves of *Robinia pseudacacia*, and of Mn and Cu in *Acer platanoides*, changes.

It is known that in big cities, industrial regions, the leaves of trees contain the various oligo-elements, heavy metals in a greater quantity (cf. SMITH 1972, HAMPP 1973, LERCHE and BRECKLE 1974, MAJERUS and DENAEYER-DE SMET 1974, DELCARTE and IMPENS 1976, DELCARTE et al. 1976, KOSLOW et al. 1977, THOMAS 1977, BACSÓ et al. 1978, MOLSKI 1978, TÖRÖK 1979, etc.).

These elements accumulate in the different tree species in certain amounts (it is partly a species specific characteristic, and partly depends on the extent of load).

2. *Biological indicators-monitors*

The tree species examined are suitable for indicating the following elements and heavy metals:
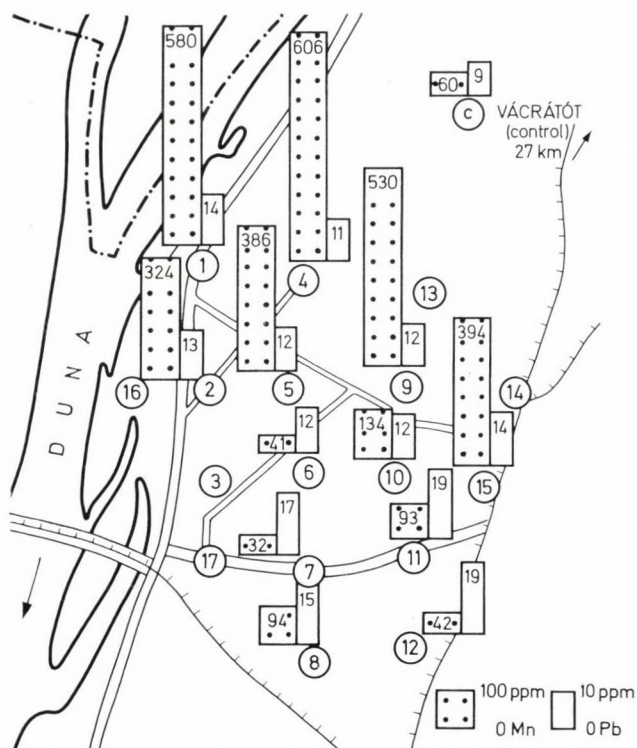
Fig. 3. Mn- and Pb-content of *Acer platanoides* leaves

Both *Robinia pseudacacia* and *Acer platanoides* are suitable for the indication of iron. The lowest quantity of iron was measured in the control in both species (cf. Tables 1—2 and Figs 1—2), and also the number of significant deviations was the highest here. On the other hand, *Tilia tomentosa* presumably does not discriminate up to a certain Fe-concentration, and takes up more iron only in the case of a higher iron-content of the soil. This statement seems to be supported by the iron content of the control sample which rather approximates the total average (Table 3).

For the indication of manganese, *Acer platanoides* seems to the most suitable (Fig. 3). The Mn content of *Acer* leaves can in certain cases reach 10—14 times the value of the Mn content in *Robinia pseudacacia* and *Tilia tomentosa* leaves originating from the same place! At the same time, in several samples the Mn content of *Acer* is the same as the Mn concentration in the leaves of the other two species. Thus *Robinia* and *Tilia* do not take up more manganese than the average, not even in highly polluted places.

TILIA TOMENTOSA
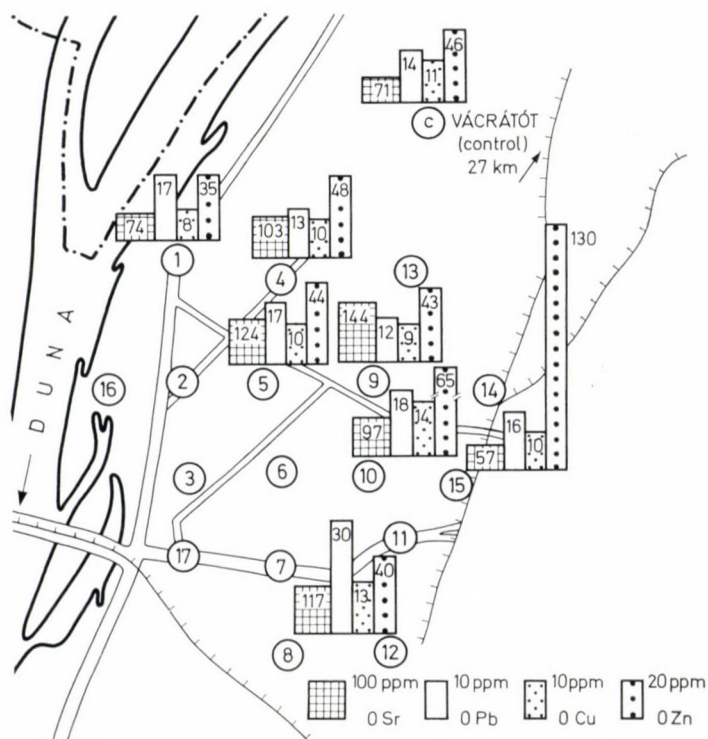
Fig. 4. The Sr-, Pb-, Cu-, and Zn-content of *Tilia tomentosa* leaves

Strontium load is mostly detectable in the leaves of *Tilia tomentosa* (Fig. 4), since this is of a significantly higher Sr content. In certain areas (for example, in sampling areas Nos. 2 and 6;* see Table 3), *Acer platanoides* and *Robinia pseudacacia* accumulate a high amount of strontium. Since no *Tilia tomentosa* samples were obtained from these places, it was only the sampling areas with presumably smaller Sr-loading that could serve as a basis for comparison.

The average copper content is nearly identical in the leaves of *Robinia pseudacacia* and *Tilia* tomentosa; in spite of this, it is only *Robinia pseudacacia* that seems suitable for the detection of Cu pollution (Fig. 5), since *Tilia tomentosa* accumulates about the same quantity of copper in the control area in the industrial urban environment. In a comparison with the control, in

* Sampling area No. 2 is in the immediate neighbourhood of an incandescent lamp factory, and No. 6 is also a nearby area, lying in the direction of the prevailing wind.

ROBINIA PSEUDOACACIA
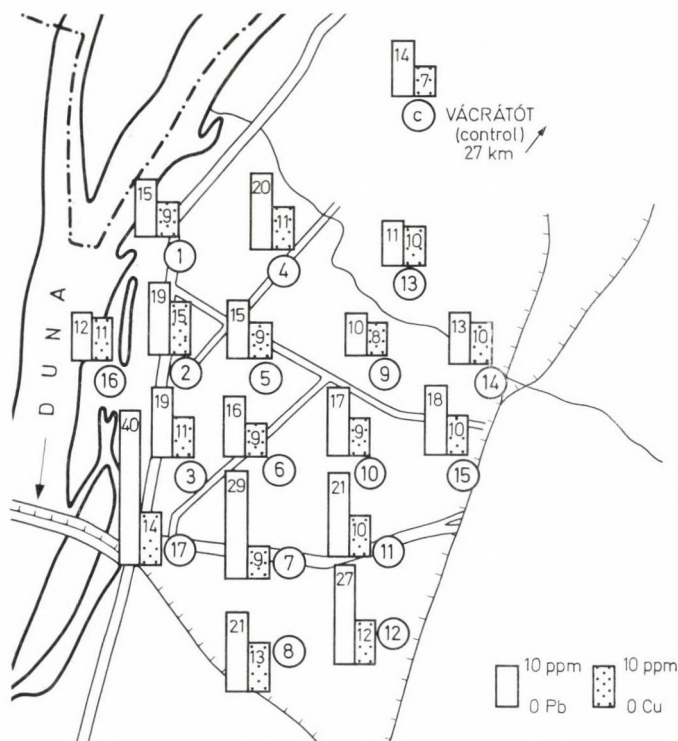
Fig. 5. Pb- and Cu-content of *Robinia pseudacacia* leaves

the loaded areas the leaves of *Robinia pseudacacia* can contain more than twice as much Cu.

Zinc is not accumulated by *Acer platanoides;* in certain sampling areas, *Robinia pseudacacia* and *Tilia tomentosa* contain 3—4 times more zinc than in the control area (see Tables 1—3).

All the three tree species are suitable for the indication of lead.

3. *The heavy metal load of industrial-urban areas*

On the basis of the element content of the three tree species, an approximate picture of the extent of the area being loaded with heavy metal and strontium can be obtained (Figs 1—6). On the basis of the data on the two resp. three tree species, the most polluted areas are as follows:
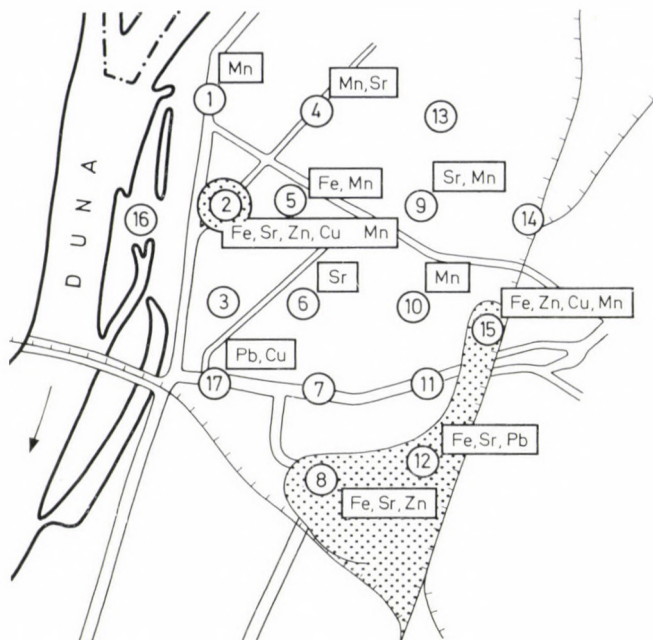
Fig. 6. Map of oligo-elements and heavy metal load in relation to one of the industrial districts of Budapest

Sampling area No. 2 (the immediate environs) of an incandescent lamp factory.

Sampling areas Nos 8, 12 and 15, which constitute a triangular field surrounded by two railway-stations and a vehicle repair shop.

On the basis of the indication by *Robinia pseudacacia,* a further very polluted area is No. 17, owing to the emission by various factories and workshops.

Summary

The tree species examined contain poly-elements like Ca, Mg, K, Na, and P in their leaves in a quantity nearly identical in the industrial-urban environment and in the control area.

They can accumulate oligo-elements like Fe, Sr, Mn, Pb, Zn, Cu in a quantity 1.2—9 times higher depending on the extent of load.

The various tree species accumulate the individual elements in proportion to their species specific characteristics and the extent of load therefore they are biological indicators, monitors of the elements mentioned.

Robinia pseudacacia indicates iron, copper, zinc and lead; *Acer platanoides* indicates manganese, and lead; *Tilia tomentosa* indicates strontium, zinc and lead.

On the basis of the chemical composition of the leaves of monitor species and the oligo-element accumulation in them, a map loading in the given area can be prepared and kind of elements and heavy metals, which are toxic also to man can be determined which we have to reckon with in the environment of the individual emmiters.

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Acta Botanica Academiae Scientiarum Hungaricae, Tomus 27 (1—2), pp. 53—103 (1981)

DER EIBENREICHE BUCHENWALD VON BAKONY-SZENTGÁL

Von

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(Eingegangen: 20. Juni 1979)

The yew — *Taxus baccata* L. — is a "perishing", anyway a declining woody plant of the European vegetation; it grows in the western part of the Northern Hungarian Mountains, the Bakony-Mountains, on a small area of 287 ha and represents an edaphic, mesoclimatic relic. The 120.000 stems and the wood mass of 600 m³ of the settling forms the greatest nature reservation treasure of the Hungarian forests.

This paper analyses on the basis of the surveys of the plant associations of 66 investigation plots the six associations of the area, it demonstrates their presence and range on a map and a cross sectional block diagram. The paper verifies that the yew-beech-wood, *Taxo-Fagetum* Moor 52, *bakonyicum* Majer 76, is an independent, natural, intrazonal association; it is very poor in species and forms a homogene association of special composition and singular physiognomy. The yew-beech-woods of the Bakony-Mountains have close plant geographical connections with the linden-yew-woods of Croatia.

Einführung

Der eibenreiche Buchenwald von Szentgál ist der größte Naturschutzort der ungarischen Wälder, der auch einen internationalen Wert besitzt. Die Eibe (*Taxus baccata* L.) ist eine »aussterbende«, jedenfalls aber eine immer seltener werdende Holzpflanze der Pflanzenwelt Europas; im Bakony-Gebirge kommt sie auf einer kleinen Fläche als edaphisches und mesoklimatisches Relikt vor.

Über die Eibe des Bakony-Gebirges wurden bereits zahlreiche popularisierende Beschreibungen herausgegeben. Zuerst hat die Diskussion von J. PADOS (1867) und A. BEDŐ (1867) in der Zeitschrift »Erdészeti Lapok« (Forstwissenschaftliche Blätter) die Aufmerksamkeit auf diesen speziellen Wald gelenkt, während von den Botanikern L. SIMONKAI (1873) als erster über die Eibe berichtete. Im weiteren sind die Besprechungen von J. KABINA (1880), V. BORBÁS (1895), J. VADAS (1898), K. SAJÓ (1899), S. MÁGOCSY-DIETZ (1905), B. PILLITZ (1908—10), L. FEKETE und T. BLATTNY (1913) und besonders die Publikationen von S. JÁVORKA (1929, 1949, 1953), R. RÉDL (1928, 1929, 1931, 1942), GY. GÁYER (1927, 1930), R. SOÓ (1939, 1945, 1962, 1964—73) beachtungswert. Auch die forstlichen Kämpfer des Naturschutzes K. KAÁN (1931), M. FÖLDVÁRY (1933, 1943), G. ROTH (1935) denken in ihren Arbeiten dem Eibenwald des Bakony-Gebirges eine bedeutende Rolle zu. Die Besprechungen von Á. BOROS (1950), G. FEKETE (1961, 1964) und J. PAPP (1960, 1965, 1975) zeugen von botanischem Interesse. Zönologische Beziehungen und ökologische Analysen sind nur in den Werken von B. ZÓLYOMI (1936, 1942, 1950, 1952, 1958), bzw. in denen von A. MAJER (1968, 1973, 1974, 1975, 1976, 1978) vorzufinden.

Ich kenne diesen Eibenwald annähernd seit einem halben Jahrhundert; ich verdanke dieses frühe Interesse meinen Professoren R. RÉDL und G. ROTH. Seit 1945 bin ich auch Verwalter und Forscher dieses Gebietes geworden. Die Felduntersuchungen wurden besonders

in den 70-er Jahren regelmässig. Ich habe über die Ergebnisse der komplexen Forschung, über die pflanzenmorphologischen und physiologischen, bzw. die geschichtlichen und standörtlichen Beziehungen, sowie über die Ergebnisse der zönologischen, forstwirtschaftlichen Untersuchungen und über die des Gartenbaus und Naturschutzes im Buch »Der Eibenwald des Bakony-Gebirges« (1978) berichtet. Das Ziel vorliegender Publikation besteht vor allem darin, daß ich die höchst interessante und eigenartige Pflanzenassoziation — den eibenreichen Buchenwald — bestimme und die Kennzeichen der Waldgesellschaft als erster beschreibe und über ihre Zusammensetzung und ökologischen Beziehungen Informationen gebe.

Geographische, standörtliche und forstgeschichtliche Beziehungen

Der Eibenwald von Szentgál umfaßt 287 ha. Er steht seit 1951 unter Naturschutz. Seine zweischichtigen Wälder befinden sich auf den nord-nordöstlichen Hängen der sog. Szentgáler Berggruppe des Bakony-Gebirges, des westlichsten Mitgliedes des Nordungarischen Mittelgebirges. Die Eiben leben auf dem Miklóspál-Berg des unteren Waldes von Szentgál (491 m), auf dem Balogszeg-Berg (440 m), sowie auf kleineren Flächen des Mögszeg-Berges (510 m) und des Mecsek-Berges (449 m) an ganz speziellen Standorten. Aus den Eiben des nördlich liegenden Borostyán-Berges (486 m) leben nunmehr kaum 5 Stück; Rédl erwähnt noch 300 Stämme.

Dieser Schollengebirgszug des in west-östlicher Richtung laufenden Hauptbruchgrabens umrahmt den südlichen Teil des sog. Séd-Tales. Das Grundgestein besteht aus Hauptdolomit aus dem oberen Trias. Wie bekannt, erleidet der Dolomit keine Verwitterung, sondern wird nur physisch abgebröckelt und bringt sog. gebrochene Hänge zustande; zwischen den Blöcken wird von den Kämmen, auf den steilen Hängen des Gebirges von den Streichen und Furchen Hangschutt zustandegebracht, während am Pediment Schuttkegel aufgebaut werden. Auf diesen Rendzinaböden, vor allem auf den braunen und rötlichen, tonhaltigen Rendzinaböden, aber an manchen Stellen sogar auf felsigem Gerüstboden, wachsen die Eiben in nördlicher, also ständig beschatteter Lage auf steilen Hängen, deren Wasserhaushalt dennoch verhältnismässig günstig ist (s. J. Koloszár 1974). Die Buche und andere Begleitholzarten bedeuten hier schon keine starke Konkurrenz. Das Kennzeichen der untiefen und schutthaltigen, sowie um etwas basischen Böden ist der hohe Humus- und C-Gehalt, der aber von keinem hohen N-Gehalt gefolgt wird; darum ist das C/N-Verhältnis auffallend hoch (4,92/0,25—19,7% !).

Die Eibe ist ein eurasisches Florenelement; aufgrund ihrer Verbreitung zeigt sie einen atlantisch-mediterranen Charakter, sie tritt demnach in Landschaften die ein ausgeglichenes und feuchtes Klima aufweisen auf. Auf den Bergen von Szentgál im Bakony-Gebirge kommt die Eibe in einer Meereshöhe von 300—450 m, meistens aber um 400 m herum massenhaft vor. Die Verhältnisse verweisen auf einen montanen Charakter und können mit der Verbreitung der Buche in Zusammenhang gebracht werden. Anderswo, so z. B. in den Karpaten und Alpen, sowie in den mediterranen Landschaften wird die Eibe eher als eine subalpine Art erwähnt und ihr Vorkommen mit der Tannenwald verknüpft. In Nordeuropa tritt sie sogar in den Tiefebenen auf. In Ungarn ist die Eibe eine Art, die die grösste Beschattung erträgt. Sie verlangt einen Schutz vom Süden her und das ist vor allem wegen der Temperaturextreme nötig; ihre Verbreitung ist nämlich sowie von der grossen Sommerdürre, als auch von den starken Winterfrösten beeinflusst. Eine mäßige Beleuchtung ist für sie günstig, auf unserem Gebiet fühlt sie sich wohl unter den locker stehenden Buchen.

Das Szentgáler-Gebirge zeigt ein spezielles Relief; auch die klimatischen Verhältnisse sind eigenartig. Das montane Makroklima ist von einer hohen Niederschlagssumme gekennzeichnet (795 mm/Jahr), deren größter Teil, 58%, in der Vegetationszeit, besonders im Mai und August fällt. 53% des Witterungsganges zeigen einen subozeanischen Charakter. Die Bewölkerung und Evaporation zeigen einen verhältnismässig hohen Wert; die relative Luftfeuchtigkeit fällt nicht unter 62%. Der Jahresmittelwert der Temperatur erreicht 9,8 °C. Die Temperaturschwankung ist äußerst niedrig, der Unterschied zwischen dem höchsten Wert von 20,2 °C im Juli und dem niedrigsten von -1,6 °C im Januar beträgt nur 21,8 °C (Monatsmittelwerte !). Diese Gegend gehört also zu den am meisten ausgeglichenen Gebieten unseres Landes. Darauf weisen auch die Länge der Vegetationszeit — 165 Tage —, sowie der Wert der Köppen-schen Cfbx-Klimatypen und der 165 Tage erreichende Wert der Szántóschen Klimabonitätskurve, ferner der in 70 bestimmte Wert des Feuchtigkeits-Versorgungsindexes hin. Obige sind für ein humides, feuchtes Klima bzw. für das Vorkommen der Buchenwälder

Abb. 1. Aussicht von der Nordteite des Miklóspál-Berges auf die Gemeinden Bánd und Herend, sowie im Vordergrund auf die Ruinen der Esseg-Burg
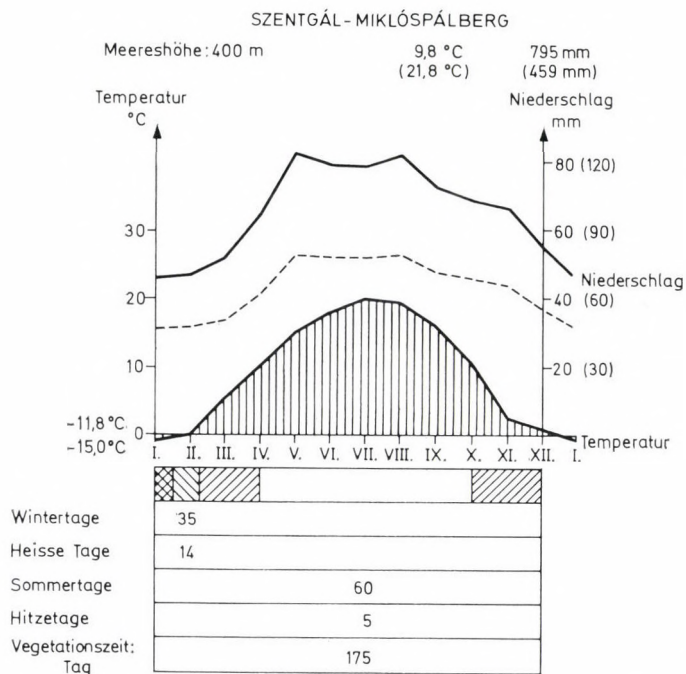
Abb. 2. WALTERsches Klimadiagramm der Jahre 1909—1950; Daten bezüglich der Nordhänge des Szentgáler Miklóspál-Berges (interpolierte Daten aus den Angaben der Meteorologischen Stationen Farkasgyepű und Keszthely)
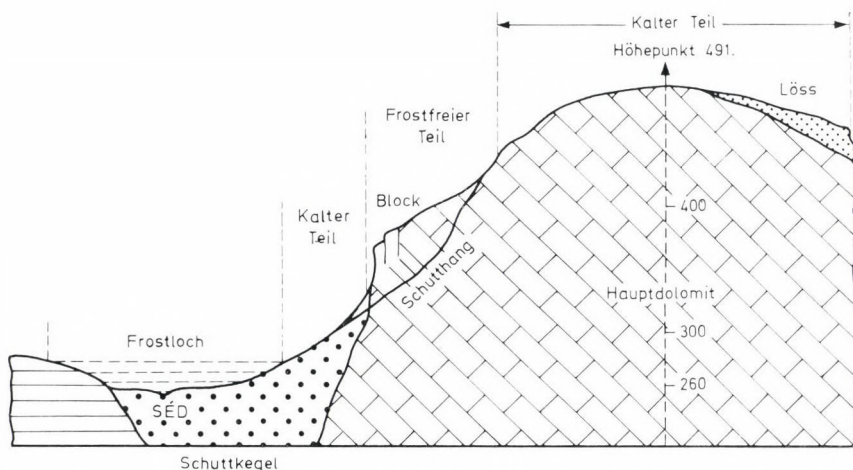
Abb. 3. Entstehung der mesoklimatischen Verhältnisse (frostfreie Teile und Frostlöcher) im Raum des Miklóspál-Berges und des Séd-Tales

charakteristisch. Außerdem kann bewiesen werden, daß die Wasserbilanz des Gebietes positiv, relativ hoch ist; sie führt zu einem Wasserüberschuß von 77 mm. Das auf das Klima des Gebietes mit mehreren Faktoren hinweisende WALTER-sche Klimadiagramm ist auf Abbildung 2 dargestellt.

Vom Gesichtspunkt des Auftretens und Fortbestehens der Eibe spielt auch das lokale, oder Mesoklima des Gebietes eine höchst bedeutende Rolle. Die nord-nordöstlichen, ständig beschatteten, steilen Hänge vermindern auch die stärkste Sonnenstrahlung etwa auf die Hälfte, bei bewölktem Wetter kann das Verhältnis der Licht- und Wärmeenergie auf 20% zurückgehen. Die in das oberste Drittel des Berghanges fallenden Furchen und Streichen — wo die eibenreichen Buchenwälder leben — widerspiegeln höchst ausgeglichene Verhältnisse. Sie sind im Sommer verhältnismäßig kühl, im Winter frostfrei und verhältnismäßig wärmer als ihre Umgebung (s. Abb. 3). Als Ergebnis der Nordwinde niederschlagen sich auf den Bäumen öfters Tau und Rauhreif, aber im Vorsommer kann nicht selten auch Hangnebel beobachtet werden. Die starke klimamodifizierende Wirkung des Reliefs wird von dem speziellen Holzbestand der Wälder gesteigert. Das Immergrün der Eibe sichert das ganze Jahr hindurch eine starke Beschattung und ein kühles, sowie ausgeglichenes Mikroklima.

Im Entstehen und Fortbestand der Eibe spielte auch der Mensch (nämlich die Szentgáler Hofjägergemeinschaft) eine weitere Rolle. Seit der Zeit der Arpaden genossen die Besitzer dieses ausgedehnten Bakonyer Waldes besondere Vorrechte. Sogar 1935 wurde auf einem mehr als 10 000 Katastraljoch ausmachenden Waldgebiet des einst 50 000 Katastraljoch umfassenden Gebietes gewirtschaftet. Anfangs sicherte die Jagd, später die Weide und das Entstehen neuer landwirtschaftlicher Gebiete durch Rodung einen hohen Wohlstand für die ursprüngliche Bevölkerung. Der untere, eibenreiche Waldteil war ein jagdfreies, geschütztes Gebiet, im schön gelegenen Wald wurde nur unregelmässig gefemelt. An Waldrodung konnte durchaus nicht gedacht werden. Im Laufe der Kommassierung in 1895 blieben die eibenreichen Buchenwälder im Besitz des adeligen Kompossessorats und das 55 Katastraljoch umfassende größte eibenreiche Gebiet des Miklóspál-Berges wurde als »angeschlossenes Glied« unter Schutz gestellt. 1945 wurde das Gebiet staatliches Eigentum und es steht seit 1951 unter Landesnaturschutz. Vor dem sehr sich vermehrten Wild ist das Gebiet heute durch einen Gitterzaun geschützt.

Die eibenreichen Waldassoziationen

In pflanzengeographischer Hinsicht gehört der Szentgáler Eibenwald zum ungarischen Florenprovinz (Pannonicum) des mitteleuropäischen Florengebietes und zum Bakony—Vértes-Florendistrikt (Veszprimense) der Florenbezirk des Ungarischen Mittelgebirges (Matricum).

In den zur Gemeinde Szentgál gehörenden Wäldern des Miklóspál- und Balogszeg-Berges, sowie in den Eibenwäldern des Mecsek- und des Mögszeg-Berges können fünf solche Assoziationen unterschieden werden, in denen Eiben vorkommen. Wir haben den eibenreichen Buchenwald außerdem — wegen abweichender Standortsgegebenheiten — in zwei Varianten, in die vom Miklóspál-Berg, sowie in die vom Balogszeg-Berg geteilt.

Die auf diese Weise ausgebildeten 6 phytozönologischen Einheiten sind folgende:

1. Laureolae-Fagetum Soó 1971, submontane Buchen-Hainbuchenwälder des ungarischen südwestlichen Mittelgebirges (Bakony—Vértes). Auf unserem Gebiet entstanden sie auf breiten Streichen, auf den höher liegenden Gebieten der Schuttkegel der Pedimente, auf braunen Waldböden mit mehr oder weniger ruhigen Bodenoberflächen.

2. Aegopodio-Alnetum Kárpáti I. et Jurko 1961. Hainbuchen-Erlenwälder der auf Pedimenten und am Fuße der Schuttkegel entstandenen Hangschuttböden.

3. Taxo-Fagetum Moor 1952, **bakonyicum** Majer 1976. Spezielle eibenreiche Buchenwälder auf den nördlich exponierten Seiten der Kämme, Felsnischen, bzw. Streichen, die auf mehr oder weniger beweglichen, schuttigen, braunen Rendzinaböden vorzufinden sind. Eine getrennte *Variante* ist die *vom Miklóspál-Berg.*

4. Taxo-Fagetum Moor 1952, **bakonyicum** Majer 1976. Die dem Bakonyer eibenreichen Buchenwald ähnliche Variante von Balogszeg entstand unter ähnlichen ökologischen Verhältnissen als den obigen.
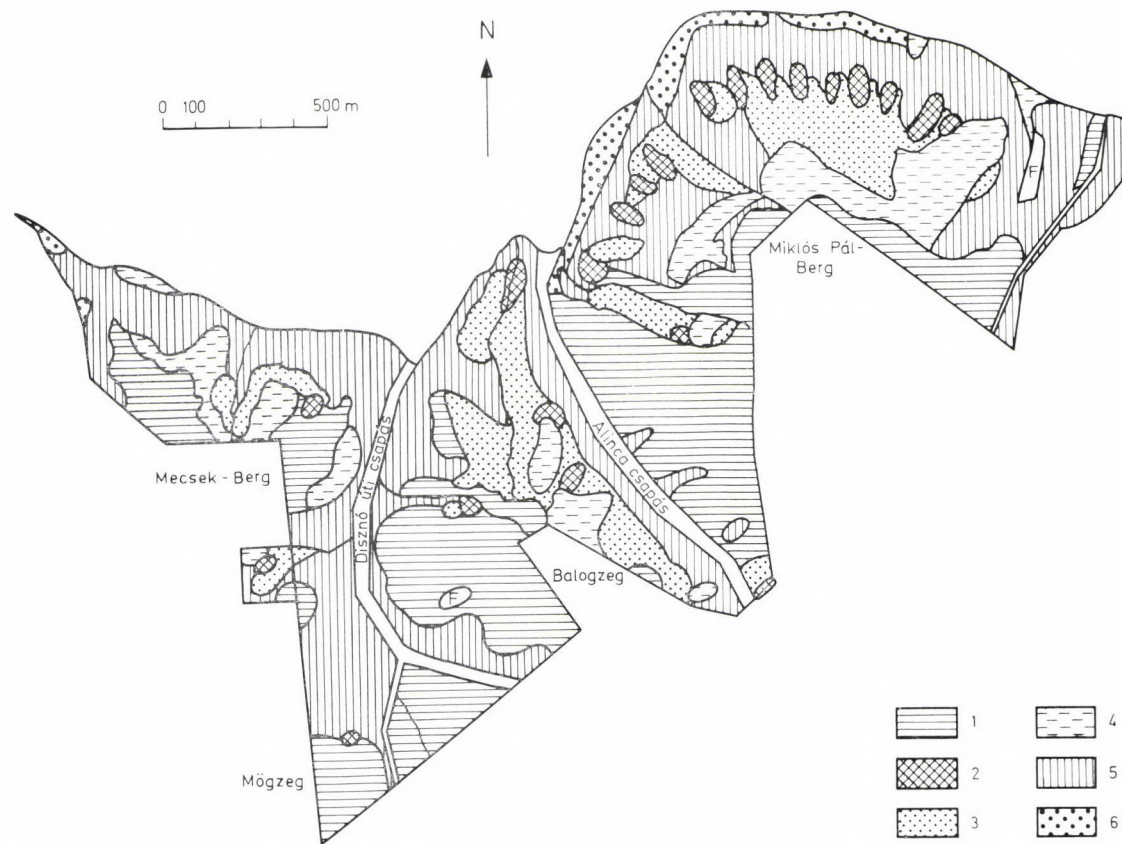
Abb. 4. Karte der Waldassoziationen des Szentgáler Eibenwaldes: — 1. Übergangsassoziatio- nen von *Querco-Carpinetum* und *Quercetum-petraeae cerris* — 2. *Fago-Ornetum*-Karstwald — 3. *Taxo-Fagetum bakonyicum* — 4. *Mercuriali-Tilietum*-Schutthangwald — 5. *Laureolae-Fagetum* — 6. *Aegopodio-Alnetum* — F = Föhren-Aufforstung
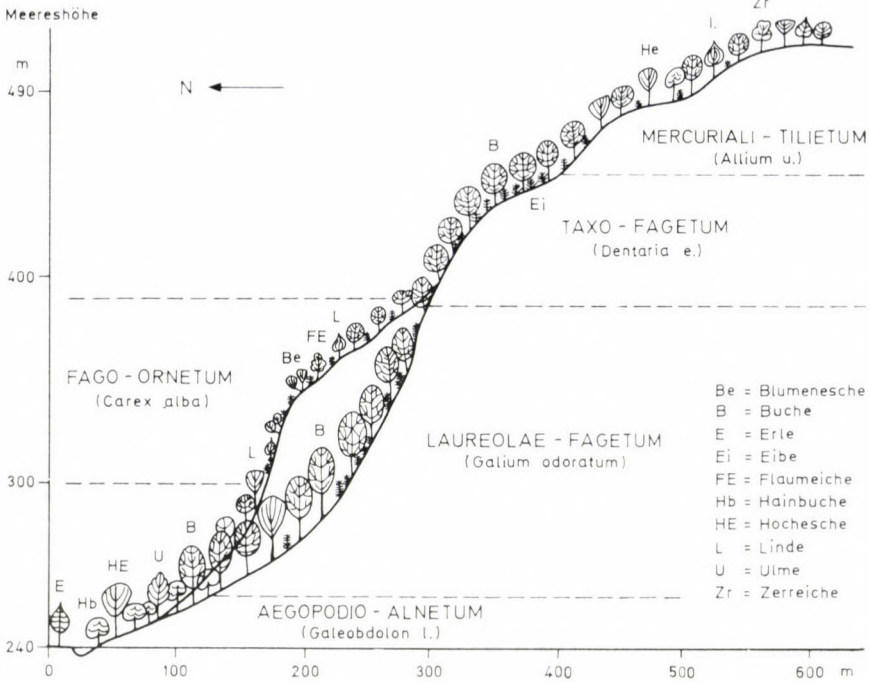
Abb. 5. Lagerung der Waldassoziationen und Waldtypen auf dem Nordhang des Miklóspál-Berges
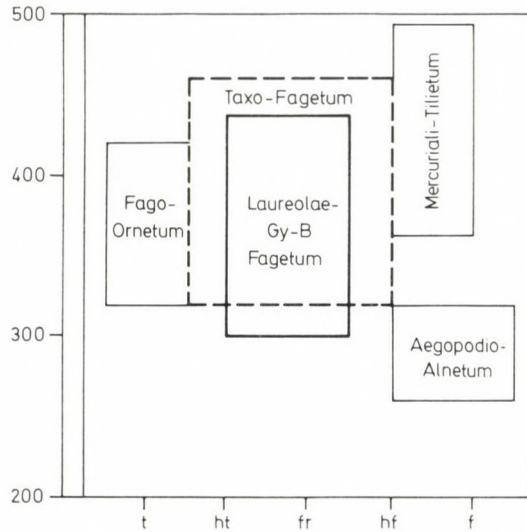
Abb. 6. Lagerung der 6 Assoziationen aufgrund der Meereshöhe und Wasserwirtschaftsstufe (t = trocken, ht = halbtrocken, fr = frisch, hf = halbfeucht, f = feucht)

5. Mercuriali-Tilietum Zólyomi 1954, **bakonyicum** Soó 1971. Linden-Eschenwälder der Schutthänge, an extremen Standorten und auf den Bakonyer Schuttböden der Bergkämme, ablaufender Bergkanten und hohler Geländeformen.
6. Fago-Ornetum (hungaricum) Zólyomi (1954), 1958. Karstwälder der Blumeneschen-Buchenwälder mit kaum geschlossenem, strauchhaltigem Holzbestand, auf den Dolomit- und Gerüstböden des ungarischen Mittelgebirges.

Auf dem geschützten Gebiet und der beigefügten Waldassoziationskarte finden wir noch weitere zwei eibenfreie Subassoziationen. Besonders auf dem Miklóspál-Berg — in nordwestlicher Exposition — befinden sich infolge starker anthropogener Einwirkung und als Ergebnis einer Holznutzungs-, Weide- und Jagdtätigkeit, in höchst degradiertem Stadium, trockene Eichenwälder; die Eichen-Zerreichenwälder *Quercetum petraeae-cerris pannonicum* Soó 1957, 1958, sowie die Eichen-Hainbuchenwälder *Quercetum petraeae-Carpinetum* Soó et Pócs 1957 *pannonicum* Soó (1934), 1957. Es handelt sich um den degradierten, mehrere Varianten zeigenden Übergangswald dieser zwei Assoziationen.

Der Überblick der eibenreichen Wälder und eibenreichen Buchenwälder wurde im System der Pflanzenassoziationen in der beigefügten Tabelle 1 dargestellt. Auf ihre Lage auf dem Gebiet wurde auf der Waldassoziationskarte und im Querschnittsumriss hingewiesen.

Untersuchungsmethode im Studium der Pflanzenassoziationen

Im Rahmen der Aufschließung und Aufnahme der Pflanzenassoziationen des Gebietes haben wir in 66 Beobachtungs- und Untersuchungsparzellen gearbeitet. Von diesen funktionierten 15 ständig; hier wurden Bodenuntersuchungen, an 8 Stellen dagegen Mikroklimamessungen vorgenommen. In weiteren 12 Parzellen haben wir detaillierte Holzbestandesstruktur- und Holzertragsaufnahmen und Analysen durchgeführt. Die Parzellen umfassen im allgemeinen eine Größe von 4 Are, sie sind demnach 20×20 m groß, zu den Untersuchungen der Holzbestandesstruktur wurden dagegen Flächen von einer Größe von 10 Are, d. h. von 20×50 m, ausgebildet. Aufnahmen wurden je Waldassoziationen in den folgenden Parzellen verfertigt:

1. *Laureolae-Fagetum*	8 Stücke
2. *Aegopodio-Alnetum*	5 Stücke
3. *Taxo-Fagetum* Mp. Var.	14 Stücke
4. *Taxo-Fagetum* Bsz. Var.	16 Stücke
5. *Mercuriali-Tilietum*	12 Stücke
6. *Orno-Fagetum*	11 Stücke
Insgesamt:	66 Stücke

Der Zeitpunkt der Vegetationsaufnahmen fiel auf den Vorfrühling Ende März und auf den Frühling, den Monat April. Die Kräuter, besonders die vorherrschenden Geophyten, treten zu dieser Zeit in Bodenvegetation unserer geschlossenen Wälder massenhaft und kennzeichnend auf. Nach der Belaubung ist ein Unterwuchs kaum mehr zu sehen; auffallend nudum wird es unter den zweischichtigen eibenreichen Buchenwäldern. In 15 Parzellen wurden zur Klärung dieses Problems im Frühling und im Sommer Untersuchungen durchgeführt.

Die beigefügten Pflanzenlisten wurden aufgrund der sechs Assoziationen zusammengestellt. Außer den A-D-Werten der Pflanzenarten sind die Deckung und die Dominanz im Prozentwert, bzw. im Durchschnitt der Aufnahmen dargestellt. Die Schichten sind folgende:

A_1 = obere Laubkronenschicht
A_2 = untere Laubkronenschicht
B = Strauchschicht
C = Rasenschicht (Krautschicht)
D = Moosschicht

Die Pflanzenarten wurden im weiteren aufgrund des zönologischen Charakters in Gruppen I—X (Majer 1978) und nach den ökologischen Artengruppen (Gruppen 1—26) zusammen-

Tabelle 1

Überblick der Bakonyer eibenreichen Buchenwälder im System der Pflanzenassoziationen

Zönologische Einheit	1	2	3	4	5	6
Division			*Querco-Fagea*			
Klasse			*Carpino-Fagetea*			*Quercetea pubescenti-petraeae*
Ordnung			*Fagetalia*			*Orno-Cotinetalia*
Verband	*Fagion medio-europaeum*	*Alno-Padion*	*Fagion medio-europaeum*			*Orno-Cotinion*
Subverband	*Asperulo-Fagion*	*Alnion glutinosae-incanae*	*Cephalanthero-Fagion*		*Tilio-Acerion*	—
Assoziation	*Laureolae-Fagetum*	*Aegopodio-Alnetum*	*Taxo-Fagetum bakonyicum*		*Mercuriali-Tilietum*	*Fago-Ornetum*
Lokale Assoziation			Miklóspál-Berg	Balogszeg–Berg		
Waldtypengruppen	*Fageta*	*Fraxino-Alneta*	*Tilio-Fraxino-Acereta*			

Tabelle 2

Artengruppen der Bakonyer eibenreichen Buchenwälder

Zönologische Artengruppe	Ökologische Artengruppe
I. Xerophile Buchen-Hainbuchenwälder	1. *Melica uniflora* 2. *Carex pilosa* 3. *Stellaria holostea*
II. Mesophile Buchen-Hainbuchenwälder	4. *Galium odoratum* 5. *Brachypodium silvaticum*
III. Subhygrophile Buchen-Hainbuchenwälder	6. *Geum urbanum* 7. *Galeobdolon luteum* 8. *Aegopodium podagraria* 10. *Corydalis cava*
IV. Hygrophil-nitrophile Buchen-Hainbuchenwälder	9. *Urtica dioica* 12. *Atropa belladonna*
V. Hygrophile, montane Buchen- und Schluchtwälder	11. *Lunaria rediviva* 22. *Festuca altissima*
VI. Xerophil-basiphile Eichenwälder	13. *Inula* 14. *Geranium sanguineum* 15. *Dictamnus albus* 16. *Lithospermum purpureo-coeruleum* 21. *Calamagrostis varia*
VII. Mesophil-neutrophile Wälder	17. *Poa nemoralis* 18. *Lathyrus niger* 19. *Convallaria majalis*
VIII. Azidiphile, xeromesophile Wälder	23. *Hieracium sylvaticum* 24. *Antennaria dioica* 25. *Jasione montana*
IX. Einjährige (Robinien)	26. *Bromus sterilis*
X. Hygrophile Erlenwälder	20. *Lythrum salicaria*

gefaßt [I. Csapody—A. Horánszky—T. Pócs—T. Simon—I. Szodfridt—P. Tallós (1963-) ferner Ellenberg (1963), H. Mayer (1977)]. Die Arten wurden innerhalb der Gruppen aufgrund der Konstanzstufen behandelt. Aus praktischen Gründen haben wir bei der Charakterisierung der Massenverhältnisse den sog. Dominanzkonstanzindex (DK) (Schlenker 1950) angegeben.

Im Laufe der synökologischen Untersuchungen wurde die gebräuchliche Analyse der Florenelemente und der Lebensform, sodann die neuartige zönologisch-ökologische Artengruppenanalyse ebenfalls durchgeführt.

Beschreibung der sechs Assoziationen des Gebietes

Die Beziehung zwischen der Meereshöhe und der Wasserwirtschaft der Waldgesellschaften ist in Abb. 6 dargelegt, während der Zusammenhang zwischen der Meereshöhe, der Exposition und dem Neigungswinkel auf Abb. 7 dargestellt wurde.
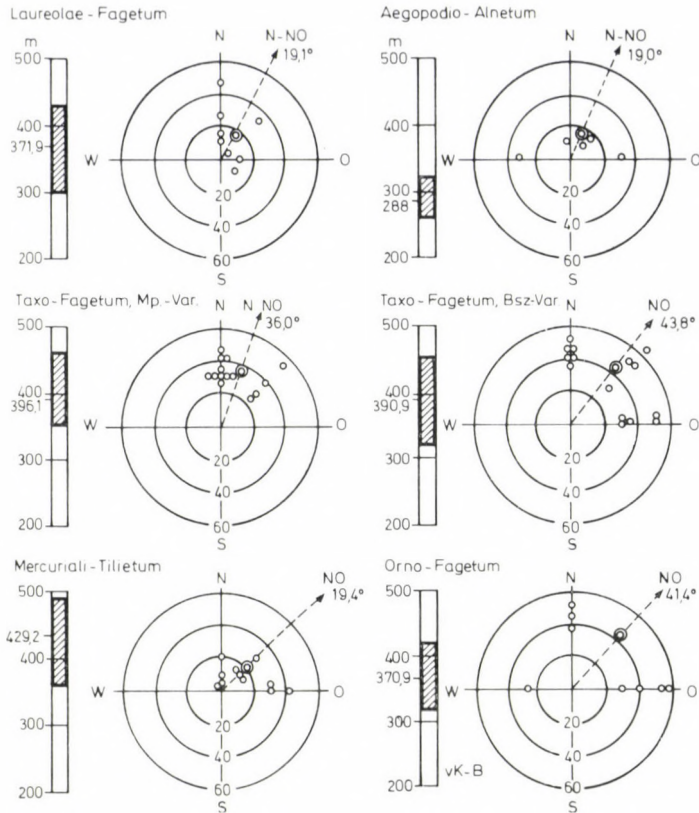
Abb. 7. Die Lagerung, Meereshöhe, Exposition und den Neigungswinkel angebenden Graphikons der 6 eigenartigen Assoziationen des Szentgáler Eibenwaldes

Charakterisierung der sechs Waldassoziationen

A) Laureolae-Fagetum Soó 1971.

Die submediterranen Buchen-Hainbuchenwälder des Transdanubischen Mittelgebirges entstanden auf unserem Gebiet unter dem Einfluß der frischen Nordhänge. Sie sind extrazonal und können als solche auf unserem Gebiet als das Endstadium der Waldentwicklung betrachtet werden.

Sie ist eine verhältnismäßig artenreiche Assoziation; in ihrer Gemeinschaft leben 16 Baum-, 16 Straucharten und 49 Krautarten. In der oberen Schicht herrscht die Buche (*Fagus silvatica*) mit einem Deckungswert von 72,5% vor. In der unteren Schicht dominieren die Eiben (*Taxus baccata*) und die Buchen. Ihre Strauchschicht und Rasenschicht ist verhältnismässig spärlich, im ganzen nur 11 bzw. 27%. Die Rasenschicht ist im Sommer nudum, nur hie und da tritt *Galium odoratum* auf. Sie kann dem Buchen-Hainbuchentyp zugeordnet werden. Nur in zwei Aufnahmen herrschen *Melica uniflora* bzw. *Allium ursinum* vor.

Konstante Arten der Assoziation sind die Buche und die Eibe, sowie *Hedera helix* und *Galium odoratum*. Subkonstante Arten sind *Carpinus betulus*, *Dentaria bulbifera* und *Allium*

ursinum. In ihrer Laubkronenschicht kommen noch *Fraxinus excelsior*, *Fraxinus ornus*, *Quercus cerris*, *Acer campestre* und *Ulmus glabra* häufig vor.

Ihre Zusammensetzung weist eher einen atlantisch-mediterranen Charakter auf, mitteleuropäische, montane und *Fagetalia*-Elemente herrschen vor. Den Großteil der zönologisch-ökologischen Artengruppe machen die mesophilen Buchen-Hainbuchenarten aus.

In synökologischer Hinsicht sind die mesophilen, basiklinen und mäßig nitrogenbeanspruchenden Arten typisch.

B) **Aegopodio-Alnetum** Kárpáti I. et Jurkó 1961.

Die Hainbuchen-Erlenwälder der Pedimente von Mittelgebirgen entwickeln sich auf unserem Gebiet auf Schutthangböden. Die Assoziation ist azonal. Das sickernde Wasser bringt auf dem Pediment etwas feuchtere Verhältnisse zustande.

Im Mischwald herrschen die Buche (*Fagus silvatica*), die Hainbuche (*Carpinus betulus*), die Hochesche (*Fraxinus excelsior*) und der Feldahorn (*Acer campestre*) vor, aber auch das Auftreten von *Acer pseudo-platanus*, *Tilia platyphyllos*, *Ulmus minor* und besonders von *Alnus glutinosa*, sowie das vereinzelte Vorkommen von *Prunus avium* ist kennzeichnend. Eiben (*Taxus baccata*) kommen in verhältnismässig kleiner Zahl vor.

Die Assoziation hat eine sehr spärliche Strauchschicht und auch in der Rasenschicht haben nur die Geophyten des Frühlingsaspekts eine gewisse Bedeutung. Vorherrschend und waldtypenbildend ist *Galeobdolon luteum*. Unter den Sträuchern ist das Erscheinen von *Staphylea pinnata*, im Unterwuchs dagegen das massenhafte Vorkommen der Geophyten im Frühling interessant. Zu den letzteren gehören: *Galanthus nivalis*, *Corydalis cava*, *Allium ursinum*, *Arum maculatum*, *Asarum europaeum* sowie *Aegopodium podagraria* und *Galium odoratum*.

Auch hier sind die mitteleuropäischen Elemente und die *Fagetalia*-Arten kennzeichnend, aber auch die Zahl der *F.-Acerion*-Arten ist hoch. Im Unterwuchs kommen verhältnismässig viele Chamaephyten vor.

In synökologischer Hinsicht ist sie eine subhygrophile, basikline und eher etwas nitrophile Assoziation.

C) **Taxo-Fagetum** Moor 1952, **bakonyicum** Majer 1976. **Variante vom Miklóspál-Berg.**

Das charakteristischste Vorkommen des Bakonyer eibenreichen Buchenwaldes ist auf dem Miklóspál-Berg von Szentgál festzustellen; der Wald kommt auf dolomitschutthaltigem, braunem Rendzinaboden, auf einem nördlich exponierten, steilen (20—50°) Hang, immer in starker Beschattung vor. Die Assoziation ist azonal, eher intrazonal; in Hinsicht auf die Eibe ist das Gebiet ein optimales Biotop.

Die Assoziation ist höchst artenarm, es herrschen in ihr die Holzpflanzen vor; von 44 Pflanzenarten gehören 12 zu den Baumarten. Die obere Schicht der Assoziation von eigenartiger Physiognomie besteht aus Buchen (*Fagus silvatica*) mit einer lockereren Deckung, während in der unteren Laubkronenschicht die einen höheren Deckungswert (70—100%) zeigende Eibe (*Taxus baccata*) vorherrscht. In der Laubkronenschicht kommen sporadisch *Fraxinus ornus*, *Tilia platyphyllos* und *Acer platanoides* vor.

Infolge der geschlossenen Eibenschicht kann sich die Strauch- und Rasenschicht der Assoziation kaum entwickeln. Für die Strauchschicht ist die immergrüne, atlantisch-mediterrane Art *Daphne laureola* charakteristisch. Die Krautschicht ist im Sommer im allgemeinen pflanzenfrei. Im Frühling kann sie jedoch durch die montane, illyrische Art *Dentaria enneaphyllos* gekennzeichnet werden. Vereinzelt kommen *Galium odoratum* und *Hedera helix* beinahe überall vor.

Die Assoziation besteht aus europäischen und mitteleuropäischen Florenelementen, vor allem aus atlantisch-mediterranen Arten. Die Buchenwaldelemente (*Fagetalia*) herrschen vor,

Tabelle 3

Assoziation 1.: Pflanzenarten von Laureolae-Fagetum, Soó, 71
(Bakonyer Buchen-Hainbuchenwald)

Schicht	Pflanzenart	$\bar{D}$	A–D	K	$\bar{D} \cdot K$	Ökologische Gruppe
	I. Ökologische Gruppe des xerophilen Buchen-Hainbuchenwaldes					
A_1	*Carpinus betulus* L.	5,9	+–2	IV	24	1
A_2	*Carpinus betulus* L.	1,5	+–2	III	5	
B	*Carpinus betulus* L.	0,2	–+	II	1	
A_2	*Acer platanoides*	0,2	–+	II	1	1
A_2	*Prunus avium* L.	0,2	–+	II	1	1
A_1	*Tilia cordata* Mill.	0,1	+	I	—	2
B	*Lonicera xylosteum* L.	0,2	–+	II	1	1
C	*Hedera helix* L.	1,1	+–1	V	6	3
C	*Dentaria bulbifera* L.	3,6	+–2	IV	14	2
C	*Melica uniflora* Retz.	6,4	+–3	III	19	1
C	*Lilium Martagon* L.	0,4	–+	III	2	1
C	*Carex pilosa* Scop.	0,2	+–1	II	1	2
C	*Lathyrus vernus* (L.) Bernh.	0,1	+	+	—	2
C	*Lathyrus venetus* (Mill.) Wohlf.	0,1	+	+	—	2
C	*Cephalanthera longifolia* (L.) Fritsch	0,1	+	+	—	2
C	*Galium silvaticum* L.	0,1	+	+	—	3
C	*Viola alba* Bess.	0,1	+	+	—	2
C	*Polygonatum multiflorum* (L.) All.	0,1	+	+	—	3
	II. Ökologische Gruppe des mesophilen Buchen-Hainbuchenwaldes					
A_1	*Fagus silvatica* L.	60,0	3–5	V	300	4
A_2	*Fagus silvatica* L.	0,1	+	+	—	
B	*Fagus silvatica* L.	0,2	–+	II	1	
B	*Corylus avellana* L.	1,6	+–2	III	5	5
B	*Crataegus oxyacantha* L.	1,0	+–1	III	3	5
B	*Daphne laureola* L.	0,2	–+	II	1	4
C	*Asperula odorata* L. (Galium o.)	6,2	+–2	V	31	4
C	*Viola silvestris* Lam. em. Rchb.	0,4	–+	III	2	4
C	*Mycelis muralis* (L.) Dum.	0,2	–+	II	1	5
C	*Dactylis polygama* Horvátovszky	0,2	–+	II	1	5
C	*Symphytum tuberosum* L.	0,2	–+	II	1	4
C	*Brachypodium silvaticum* (Huds.) P. B.	0,1	+	+	—	5
C	*Neottia nidus-avis* (L.) Rich.	0,1	+	+	—	4
C	*Ajuga reptans* L.	0,1	+	+	—	5
C	*Euphorbia amygdaloides* L.	0,1	+	+	—	4
C	*Bilderdykia dumetorum* (L.) Dum.	0,1	+	+	—	5
	III. Ökologische Gruppe des subhygrophilen Buchen-Hainbuchenwaldes					
B	*Crataegus monogyna* Jacq.	0,4	–+	III	2	6
B	*Euonymus europaeus* L.	0,1	+	+	—	6
B	*Cornus sanguinea* L.	0,2	–+	II	1	6
C	*Allium ursinum* L.	3,1	+–2	IV	12	10
C	*Galeobdolon luteum* Huds.	0,5	–+	III	2	7
C	*Galanthus nivalis* L.	1,1	+–1	III	3	7

Tabelle 3 (Fortsetzung)

Schicht	Pflanzenart	$\bar{D}$	A–D	K	$\bar{D} \cdot K$	Ökologische Gruppe
C	*Asarum europaeum* L.	0,4	—+	III	2	7
C	*Cordydalis cava* Schw. et K.	0,2	—+	II	1	10
C	*Anemone ranunculoides* L.	0,2	—+	II	1	10
C	*Arum maculatum* L.	0,2	—+	II	1	10
C	*Geum urbanum* L.	0,2	—+	II	1	6
C	*Clematis vitalba* L.	0,2	—+	II	1	6
C	*Aegopodium podagraria* L.	0,1	+	+	—	6
C	*Isopyrum thalictroides* L.	0,1	+	+	—	10
C	*Pulmonaria officinalis* L.	0,1	+	+	—	7
C	*Vicia sepium* L.	0,1	+	+	—	6
	IV. Ökologische Gruppe des hygro-nitrophilen Buchen-Hainbuchenwaldes					
B	*Sambucus nigra* L.	0,1	+	+	—	9
C	*Galium aparine* L.	0,1	+	+	—	9
	V. Ökologische Gruppe der hygrophilen, montanen Buchenwälder und Schluchtwälder					
A_2	*Taxus baccata* L.	27,6	+—5	V	138	22
B	*Taxus baccata* L.	1,8	+—2	IV	11	
B	*Ulmus glabra* Huds.	0,2	—+	II	1	11
C	*Dentaria enneaphyllos* L.	2,8	+—2	III	8	22
C	*Mercurialis perennis* L.	0,5	—+	III	2	11
C	*Glechoma hirsuta* W. et K.	0,1	—+	III	1	11
	VI. Ökologische Gruppe der xero-basiphilen Eichenwälder					
A_1	*Fraxinus excelsior* L.	0,1	+	+	—	21
A_2	*Fraxinus excelsior* L.	7,5	2—4	II	15	
B	*Fraxinus excelsior* L.	1,6	+—2	III	5	
A_1	*Fraxinus ornus* L.	0,2	+	II	1	14
A_2	*Fraxinus ornus* L.	2,5	+—2	III	8	
A_1	*Quercus pubescens* Willd.	0,1	+	+	—	14
A_2	*Tilia platyphyllos* Scop.	1,4	+—2	II	3	21
B	*Cornus mas* L.	0,4	—+	III	2	21
B	*Viburnum lantana* L.	0,2	—+	II	1	14
B	*Staphylea pinnata* L.	0,3	—+1	II	2	21
B	*Rosa arvensis* Huds.	0,2	—+	II	1	13
B	*Berberis vulgaris* L.	0,1	+	+	—	15
B	*Euonymus verrucosus* Scop.	0,1	+	+	—	15
B	*Rosa canina* L.	0,1	+	+	—	13
C	*Lithospermum purpureo-coeruleum* L.	0,1	+	+	—	16
C	*Veratrum nigrum* L.	0,1	+	+	—	16
C	*Galium Mollugo* L.	0,1	+	+	—	14
	VII. Ökologische Gruppe der meso-neutrophilen Eichenwälder					
A_1	*Quercus cerris* L.	5,0	—2	II	10	17
A_1	*Acer campestre* L.	1,5	1—2	II	4	17
A_2	*Acer campestre* L.	1,4	+—2	II	3	

Tabelle 3 (Fortsetzung)

Schicht	Pflanzenart	$\bar{D}$	A–D	K	$\bar{D}\cdot K$	Ökologische Gruppe
A_1	*Quercus petraea* (Matt.) Lieblein	0,1	+	+	—	18
A_1	*Ulmus minor* Mill.	0,1	+	+	—	17
B	*Pyrus pyraster* Burgsdorf	0,1	+	+	—	17
B	*Viburnum opulus* L.	0,1	+	+	—	19
C	*Viola hirta* L.	0,2	—+	II	—	18
C	*Viola odorata* L.	0,1	+	+	—	19
C	*Melittis grandiflora* Salisb.	0,1	+	+	—	17
C	*Convallaria majalis* L.	0,1	+	+	—	19
C	*Clinopodium vulgare* L.	0,1	+	+	—	17
C	*Hypericum montanum* L.	0,1	+	+	—	17
	VIII. Ökologische Gruppe der azidophilen, xero-mesophilen Wälder					
C	*Hieracium sabaudum* L.	0,1	+	+	—	23
	IX. Ökologische Gruppe der einjährigen (Robinien) Arten					
C	*Alliaria petiolata* (MB) Cav. et Grande	0,2	—+	II	1	26

Zahl der Aufnahmeparzellen:		8
Höhe über dem Meeresspiegel:		371,9 (300—435) m
Durchschn. Neigungswinkel:		19,1 (5—45)
Durchschn. Baumbestand:		194,5 m³/ha
Holzertragsklasse:		5,75 (VI)
Fazies: Nudum		75%
Melica uniflora		25%
Durchschnittswert der Deckung:	A_1-Schicht	72,5%
	A_2-Schicht	42,5%
	B-Schicht	11,2%
	C-Schicht	27,3%

* Zeichenerklärung: A_1 = obere Laubkronenschicht
A_2 = untere Laubkronenschicht
B = Strauchschicht
C = Rasenschicht
D = Moosschicht

aber auch das Auftreten von *Cephalanthero-Fagion-* und der bereits wärmeren *Orno-Cotinetalia*-Arten ist bedeutend.

Auf ihre Assoziations- und Umweltverhältnisse weisen die mesophilen, montanen Buchenarten hin, so sind die Buchen-Hainbuchenwälder dominierend. Für die montanartige Rasenschicht sind eher die Hemikryptophyten typisch.

Was den synökologischen Charakter anbetrifft, so herrschen in erster Reihe die subhygrophilen, eher basiphilen, aber weniger Nitrogen beanspruchenden Arten vor.

D) **Taxo-Fagetum** Moor 1952, **bakonyicum** Majer 1976. **Variante vom Balogszeg-Berg.**

Der eibenreiche Buchenwald ist eine intrazonale Assoziation, die auf den nördlich exponierten (30—60°), sehr steilen und schutthaltigen, braune und schwarze Renzinaböden — an einigen Stellen sogar bereits steinige Gerüstböden — zeigenden Hängen des Balogszeg-, Mögszeg- und Mecsek-Berges auftritt.

Tabelle 4

Assoziation 2.: Aegopdio-Alnetum pannonicum, Kárpáti I. et Jurko, 61
(Pflanzenarten des Hainbuchen-Erlenwaldes auf dem Mittelgebirgspediment)

Schicht	Pflanzenart	$\bar{D}$	A–D	K	$\bar{D} \cdot K$	Ökologische Gruppe
	I. Ökologische Gruppe des xerophilen Buchen-Hainbuchenwaldes					
A_1	*Carpinus betulus* L.	14,2	+–3	IV	57	1
A_1	*Acer platanoides* L.	0,4	–+	II	1	1
A_1	*Prunus avium* L.	0,2	+	I	—	1
B	*Lonicera xylosteum* L.	0,4	+	II	1	1
C	*Dentaria bulbifera* L.	4,4	+–2	III	13	2
C	*Hedera helix* L.	1,4	+–1	III	4	3
C	*Lathyrus vernus* (L.) Bernh.	0,4	–+	II	1	2
C	*Lathyrus venetus* (Mill.) Wohlf.	0,2	+	I	—	2
	II. Ökologische Gruppe des mesophilen Buchen-Hainbuchenwaldes					
A_1	*Fagus silvatica* L.	48,0	2,5	V	240	4
B	*Daphne mezereum* L.	0,6	–+	III	2	4
B	*Corylus avellana* L.	0,4	–+	II	1	5
B	*Crataegus oxyacantha* L.	0,2	+	I	—	5
C	*Galium odoratum* (L.) Scop.	4,2	+–2	IV	17	4
C	*Viola silvestris* Lam. em. Rchb.	0,6	–+	III	2	4
C	*Mycelis muralis* (L.) Dum.	0,4	–+	II	1	5
C	*Sanicula europaea* L.	0,2	+	I	—	4
C	*Actaea spicata* L.	0,2	+	I	—	4
C	*Euphorbia amygdaloides* L.	0,2	+	I	—	4
	III. Ökologische Gruppe des subhygrophilen Buchen-Hainbuchenwaldes					
B	*Cornus sanguinea* L.	0,2	+	I	—	6
B	*Euonymus europaeus* L.	0,2	+	I	—	6
B	*Crataegus monogyna* Jacq.	0,2	+	I	—	6
C	*Galeobdolon luteum* L.	12,0	2	V	60	7
C	*Aegopodium podagraria* L.	2,4	+–1	IV	10	8
C	*Allium ursinum* L.	0,8	–+	IV	3	10
C	*Corydalis cava* Schw. et K.	7,4	+–3	IV	30	10
C	*Asarum europaeum* L.	1,6	+–1	IV	8	7
C	*Arum maculatum* L.	0,8	–+	IV	3	10
C	*Galanthus nivalis* L.	2,6	+–2	IV	10	7
C	*Anemone ranunculoides* L.	0,6	–+	III	2	10
C	*Aconitum vulparia* Rchb.	0,6	–+	III	2	7
C	*Pulmonaria officinalis* L.	0,4	–+	II	1	7
C	*Knautia drymeia* Heuff.	0,4	–+	II	1	7
C	*Ranunculus ficaria* L.	0,2	+	I	—	10
	IV. Ökologische Gruppe des hygro-nitrophilen Buchen-Hainbuchenwaldes					
B	*Sambucus nigra* L.	0,4	+	II	1	5
C	*Chelidonium majus* L.	0,4	+	IV	1	9

Tabelle 4 (Fortsetzung)

Schicht	Pflanzenart	$\bar{D}$	A–D	K	$\bar{D} \cdot K$	Ökologische Gruppe
	V. Ökologische Gruppe der hygrophilen, montanen Buchenwälder und Schluchtwälder					
A_2	*Taxus baccata* L.	12,4	+–3	V	50	22
B	*Taxus baccata* L.	0,2	+	(I)	—	22
A_1	*Acer pseudo-platanus* L.	0,6	+	III	2	11
A_2	*Acer pseudo-platanus* L.	0,2	+	I	—	11
C	*Mercurialis perennis* L.	1,6	+–1	III	5	11
C	*Dentaria enneaphyllos* L.	10,0	2–3	II	20	32
	VI. Ökologische Gruppe der xero-basiphilen Eichenwälder					
A_1	*Fraxinus excelsior* L.	7,4	+–2	V	37	21
B	*Fraxinus excelsior* L.	0,6	+	III	2	21
A_1	*Tilia platyphyllos* Scop.	1,0	–1	I	1	21
B	*Staphylea pinnata* L.	0,8	–+	IV	3	21
B	*Euonymus verrucosus* Scop.	0,2	+	I	—	15
	VII. Ökologische Gruppe der meso-neutrophilen Eichenwälder					
A_1	*Acer campestre* L.	3,4	+–2	III	11	17
A_1	*Ulmus minor* Mill.	0,6	+	III	2	17
A_1	*Quercus cerris* L.	2,0	2	I	2	17
C	*Convallaria majalis* L.	0,2	+	I	—	19
	VIII. Ökologische Gruppe der hygrophilen Erlenwälder					
A_1	*Alnus glutinosa* (L.) Gärtn.	0,2	+	I	—	20

Zahl der Aufnahmeparzellen:		5
Höhe über dem Meeresspiegel:		288 (260–320) m
Durchschn. Neigungswinkel:		19,0 (10–30)
Durchschn. Baumbestand:		276,4 m³/ha
Holzertragsklasse:		3,0 (III)
Fazies: *Galeobdolon luteum*		100%
Durchschnittswert der Deckung:	A_1-Schicht	81,0%
	A_2-Schicht	12,4%
	B-Schicht	8,2%
	C-Schicht	60,0%

Die Waldgesellschaft besteht aus zahlreicheren und trockeneren Arten als der eibenreiche Buchenwald des Miklóspál-Berges. Die Artenzahl erreicht 55, außer der in der Laubkronenschicht vorherrschenden Buche (*Fagus silvatica*) kommen noch *Carpinus betulus*, *Acer platanoides*, *Acer campestre*, *Fraxinus ornus* in einer verhältnismässig hohen Zahl vor, aber auch *Fraxinus excelsior*, *Acer pseudo-platanus*, *Quercus cerris*, *Quercus petraea*, *Quercus pubescens* und *Sorbus torminalis* tritt stellenweise auf. Die untere Laubkronenschicht zeigt eine durchschnittlich 70prozentige Deckung der Eibe (*Taxus baccata*), ihr Deckungswert erreicht

Abb. 8. Typische zweischichtige Holzbestände des eibenreichen Buchenwaldes (*Taxo-Fagetum*) auf dem Miklóspál-Berg

Abb. 9. Die für die Bakonyer Buchen-Hainbuchenwälder charakteristische, namengebende, immergrüne Strauchart *Daphne laureola* ist auch für den eibenreichen Buchenwald kennzeichnend

an einigen Stellen sogar 100%. In dieser Waldassoziation sind bereits mehrere Straucharten vorzufinden. Die Rasenschicht ist im Sommer nudum, im Frühling ist außer *Dentaria enneaphyllos* das Auftreten von mehreren Frühlings-Geophyten kennzeichnend; besonders häufig tritt *Corydalis cava* und teilweise *Galanthus nivalis* und *Dentaria bulbifera* auf.

Aufgrund der Florenelemente herrschen auch hier die atlantisch-mediterranartigen europäischen und mitteleuropäischen Arten vor, aber auch das Erscheinen von östlichen, eurasischen Arten ist bedeutend; außer den *Fagetalia*-Elementen ist also die Dominanz der *Quercetalia*- und *Cephalanthero-Fagion*-Elemente charakteristisch.

Tabelle 5

Assoziation 3.: Pflanzenarten der Variante vom Miklóspál-Berg des Bakonyer eibenreichen Buchenwaldes (Taxo-Fagetum, Moor 64, *bakonyicum,* Majer 76)

Schicht	Pflanzenart	$\bar{D}$	A—D	K	$\bar{D} \cdot K$	Ökologische Gruppe
	I. Ökologische Gruppe des xerophilen Buchen-Hainbuchenwaldes					
A_1	*Acer platanoides* L.	1,5	+—2	I	2	1
B	*Prunus avium* L.	0,1	+	—	—	1
C	*Hedera helix* L.	0,9	—+	IV	4	3
C	*Dentaria bulbifera* L.	0,6	+—1	II	2	2
C	*Melica uniflora* Retz	0,2	—+	I	—	1
C	*Carex pilosa* Scop.	0,1	+	+	—	2
C	*Viola alba* Bess.	0,1	+	+	—	2
C	*Lilium martagon* L.	0,1	+	+	—	1
	II. Ökologische Gruppe des mesophilen Buchen-Hainbuchenwaldes					
A_1	*Fagus silvatica* L.	61,4	2—5	V	307	4
A_2	*Fagus silvatica* L.	0,1	+	+	—	
B	*Daphne laureola* L.	0,7	—+	IV	3	4
C	*Galium odoratum* (L.) Scop.	1,6	+—2	IV	7	4
C	*Viola silvestris* Lam. em. Rchb.	0,5	+—1	III	2	4
C	*Mycelis muralis* (L.) Dum.	0,2	—+	I	—	5
C	*Euphorbia amygdaloides* L.	0,1	+	+	—	4
C	*Fragaria vesca* L.	0,1	+	+	—	5
C	*Geranium Robertianum* L.	0,1	+	+	—	5
	III. Ökologische Gruppe des subhygrophilen Buchen-Hainbuchenwaldes					
B	*Cornus sanguinea* L.	0,1	+	+	—	6
C	*Galeobdolon luteum* L.	0,9	+—2	III	3	7
C	*Lapsana communis* L.	0,2	—+	I	—	6
C	*Aegopodium podagraria* L.	0,1	+	+	—	8
C	*Galanthus nivalis* L.	0,1	+	+	—	7
C	*Asarum europaeum* L.	0,1	+	+	—	7
C	*Clematis vitalba* L.	0,1	+	+	—	6
C	*Hypericum perforatum* L.	0,1	+	+	—	6
	IV. Ökologische Gruppe des hygro-nitrophilen Buchen-Hainbuchenwaldes					
B	*Sambucus nigra* L.	0,2	—+	I	—	9
C	*Atropa belladonna* L.	0,2	—+	I	—	12
C	*Chelidonium majus* L.	0,1	+	+	—	9
	V. Ökologische Gruppe der hygrophilen, montanen Buchenwälder und Schluchtwälder					
A_2	*Taxus baccata* L.	71,4	3—5	V	357	22
B	*Taxus baccata* L.	0,1	—+	II	1	
A_1	*Acer pseudo-platanus* L.	0,2	—+	I	—	11
A_1	*Ulmus glabra* Huds.	0,3	—+	I	1	11
C	*Dentaria enneaphyllos* L.	0,9	+—2	IV	4	22
C	*Mercurialis perennis* L.	0,1	+	+	—	11

Tabelle 5 (Fortsetzung)

Schicht	Pflanzenart	D̄	A–G	K	D̄ · K	Ökologische Gruppe
	VI. Ökologische Gruppe der xero-basiphilen Eichenwälder					
A_1	*Fraxinus ornus* L.	0,9	+—2	(IV)	4	14
A_2	*Fraxinus ornus* L.	0,1	+	+	—	
B	*Fraxinus ornus* L.	0,5	—+	III	2	
A_1	*Tilia platyphyllos* Scop.	1,1	+—2	III	4	21
B	*Fraxinus excelsior* L.	0,2	—+	I	—	21
A_1	*Sorbus torminalis* (L.) Cr.	0,1	+	+	—	16
B	*Euonymus verrucosus* Scop.	0,2	—+	+	—	15
C	*Mercurialis ovata* Sternb. et Hoppe	0,1	+	+	—	15
	VII. Ökologische Gruppe der meso-neutrophilen Eichenwälder					
A_1	*Quercus cerris* L.	0,2	—+	+	—	17
A_1	*Acer campestre* L.	0,1	+	+	—	17
C	*Convallaria majalis* L.	0,1	+	+	—	19
C	*Clinopodium vulgare* L.	0,1	+	+	—	17
C	*Viola hirta* L.	0,1	+	+	—	18
C	*Viola odorata* L.	0,1	+	+	—	19

Zahl der Aufnahmeparzellen:		14
Höhe über dem Meeresspiegel:		396,1 (350—450) m
Durchschn. Neigungswinkel:		36,0 (20—45)
Durchschn. Baumbestand:		172,3 m³/ha
Holzertragsklasse:		4,8 (V)
Facies: Nudum		100%
Durchschnittswert der Deckung:	A_1-Schicht	64,3%
	A_2-Schicht	71,4%
	B-Schicht	0,9%
	C-Schicht	4,5%

Aufgrund der zönologisch-ökologischen Artengruppen ist die Proportion der montanen, hygrophilen Wälder und der mesophilen Buchen-Hainbuchenwälder groß, aber auch der Anteil an xerophil-basiphilen Arten ist schon bedeutend.

In synökologischer Hinsicht ist die Vegetation der Assoziation noch subhygrophil, eher basiphil und mäßig nitrophil.

E) **Mercuriali-Tilietum** Zólyomi 1954, **bakonyicum** Soó 1971.

Die Assoziation besteht aus Linden-Eschen-Hangschuttwäldern. Diese entstanden auf den Kämmen unserer Dolomitberge, auf den konvexen Flächen der Hänge und meistens auf schwarzen Rendzinaböden. Die Gesellschaft ist eine edaphische Dauerwaldgesellschaft, bzw. eine azonale Assoziation. Wegen ihrer feuchteren Verhältnisse im Frühling ist sie eine artenreichere Gesellschaft; sie setzt sich aus 17 Baumarten, 56 Krautarten und einigen Straucharten zusammen. Die Geophytenvegetation ist besonders im Frühlingsaspekt reich, der Dekkungswert erreicht zu dieser Zeit 76%.

Die Laubkronenschicht ist mäßig geschlossen, außer der Buche (*Fagus silvatica*) und der Hainbuche (*Carpinus betulus*) kommen noch *Fraxinus excelsior*, *Acer campestre*, aber auch *Acer platanoides*, *Acer pseudo-platanus*, *Tilia platyphyllos*, *Quercus cerris*, *Quercus petraea*,

Tabelle 6

Assoziation 4.: Pflanzen der Variante von Balogszeg des Bakonyer eibenreichen Buchenwaldes (*Taxo-Fagetum*, Moor 64, *bakonyicum*, Majer 76)

Schicht	Pflanzenart	$\bar{D}$	A—D	K	$\bar{D}$ · K	Ökologische Gruppe
	I. Ökologische Gruppe des xerophilen Buchen-Hainbuchenwaldes					
A_1	*Carpinus betulus* L.	2,5	+—2	III	8	1
A_1	*Acer platanoides* L.	1,9	+—2	III	6	1
B	*Lonicera xylosteum* L.	0,3	—+	II	1	1
C	*Dentaria bulbifera* L.	2,0	+—2	V	10	2
C	*Hedera helix* L.	0,5	+—1	III	2	3
C	*Lilium martagon* L.	0,1	—+	II	1	1
C	*Lathyrus vernus* (L.) Bernh.	0,2	—+	I	—	2
C	*Galium silvaticum* L.	0,1	—+	I	—	3
C	*Polygonatum multiflorum* (L.) All.	0,1	—+	I	—	3
C	*Carex digitata* L.	0,1	+	+	—	2
C	*Campanula trachelium* L.	0,1	+	+	—	3
	II. Ökologische Gruppe des mesophilen Buchen-Hainbuchenwaldes					
A_1	*Fagus silvatica* L.	71,3	3—5	V	357	4
A_2	*Fagus silvatica* L.	0,8	+—2	II	2	
B	*Daphne mezereum* L.	0,1	—+	I	—	4
B	*Crataegus oxyacantha* L.	0,2	—+	I	—	5
C	*Galium odoratum* (L.) Scop.	0,4	—+	III	2	4
C..	*Viola silvestris* Lam. em. Rchb.	0,2	—+	I	—	4
C	*Mycelis muralis* (L.) Dum.	0,2	—+	I	—	5
C	*Sanicula europaea* L.	0,1	+	+	—	4
C	*Euphorbia amygdaloides* L.	0,1	+	+	—	4
C	*Actaea spicata* L.	0,1	+	+	—	4
C	*Dryopteris filixmas* (L.) Schott	0,1	+	+	—	5
	III. Ökologische Gruppe des subhygrophilen Buchen-Hainbuchenwaldes					
B	*Crataegus monogyna* Jacq.	0,1	+	+	—	6
B	*Cornus sanguinea* L.	0,1	+	+	—	6
B	*Eugnymus europaeus* L.	0,1	+	+	—	6
C	*Galanthus nivalis* L.	1,2	+—1	IV	5	7
C	*Corydalis cava* Schw. et K.	2,1	+—2	III	7	10
C	*Galeobdolon luteum* L.	0,6	—+	III	2	7
C	*Allium ursinum* L.	0,9	+—2	II	2	10
C	*Asarum europaeum* L.	0,1	—+	I	—	7
C	*Arum maculatum* L.	0,1	—+	I	—	10
C	*Anemone ranunculoides* L.	0,1	+	+	—	10
C	*Aegopodium podagraria* L.	0,1	+	+	—	8
C	*Aconitum vulparia* Rchb.	0,1	+	+	—	7
	IV. Ökologische Gruppe des hygro-nitrophilen Buchen-Hainbuchenwaldes					
C	*Galium aparine* L.	0,1	+	+	—	9
	V. Ökologische Gruppe der hygrophilen, montanen Buchenwälder und Schluchtwälder					
A_2	*Taxus baccata* L.	69,4	3—5	V	347	22
B	*Taxus baccata* L.	0,3	—+	II	1	
A_1	*Acer pseudo-platanus* L.	0,1	+	+	—	11
C	*Dentaria enneaphyllos* L.	6,9	+—2	V	35	22
C	*Mercurialis perennis* L.	0,4	—+	III	2	11

Tabelle 6 (Fortsetzung)

Schicht	Pflanzenart	$\bar{D}$	A–D	K	$\bar{D}\cdot K$	Ökologische Gruppe
	VI. Ökologische Gruppe der xero-basiphilen Eichenwälder					
A_1	*Fraxinus excelsior* L.	2,6	+–2	II	5	21
A_1	*Fraxinus ornus* L.	0,8	+–2	II	2	14
A_2	*Fraxinus ornus* L.	0,1	–+	I	—	
B	*Fraxinus ornus* L.	0,1	+	+	—	
A_1	*Sorbus torminalis* (L.) Cr.	0,1	+	+	—	16
A_2	*Sorbus torminalis* (L.) Cr.	0,1	–+	I	—	
A_1	*Tilia platyphyllos* Scop.	0,1	–+	I	—	21
B	*Euonymus verrucosus* Scop.	0,1	–+	I	—	15
B	*Viburnum lantana* L.	0,1	+	+	—	14
B	*Cornus mas* L.	0,1	+	+	—	16
B	*Rosa arvensis* Huds.	0,1	+	+	—	13
B	*Staphylea pinnata* L.	0,1	+	+	—	21
C	*Mercurialis ovata* Sternb. et Hoppe	0,4	+–2	II	1	15
C	*Polygonatum odoratum* (L.) Druce	0,1	+	+	—	15
	VII. Ökologische Gruppe der meso-neutrophilen Eichenwälder					
A_1	*Acer campestre* L.	1,9	–2	I	2	17
A_1	*Quercus cerris* L.	0,1	+	+	—	17
C	*Convallaria majalis* L.	0,2	–+	I	—	19
C	*Arabis turrita* L.	0,1	+	+	—	18
	VIII. Ökologische Gruppe der azidophilen, xero-mesophilen Wälder					
C	*Hieracium sabaudum* L.	0,1	+	+	—	23
	IX. Ökologische Gruppe der einjährigen (Robinien) Arten					
C	*Alliaria petiolata* (MB.) Cav. et Grande	0,2	–+	I	—	26

Zahl der Aufnahmeparzellen:		16
Höhe über dem Meeresspiegel:		390,9 (320–450) m
Durchschn. Neigungswinkel:		43,8 (30–60)
Durchschn. Baumbestand:		209,7 m³/ha
Holzertragsklasse:		5,3 (V)
Fazies: Nudum		50,0%
Dentaria enneaphyllos		40,0%
Dentaria bulbifera		10,0%
Durchschnittswert der Deckung:	A_1-Schicht	78,8%
	A_2-Schicht	70,0%
	B-Schicht	1,4%
	C-Schicht	12,6%
	D-Schicht	0,6%

Quercus pubescens, *Fraxinus ornus* und *Pyrus pyraster* vor. Im Unterwuchs herrscht die atlantisch-mediterranartige Krautart *Allium ursinum* vor, aber auch *Mercurialis perennis* und *Galeobdolon luteum* tritt häufig auf; unter den Geophyten wachsen zahlreiche Exemplare von *Corydalis cava*, *Galium odoratum*, *Dentaria bulbifera* und *Galanthus nivalis*.

An diesem in einem gewissen Maße extremen Standort ist die Zahl der atlantisch-mediterranen Arten nicht allzu hoch, obwohl noch die mitteleuropäischen Florenelemente

Tabelle 7

Assoziation 5.: Pflanzenarten von Mercuriali-Tilietum Zólyomi 54, bakonyicum, Soó 71
(Bakonyer lindenreiche Schutthangwälder)

Schicht	Pflanzenart	$\bar{D}$	A–D	K	$\bar{D}$ · K	Ökologische Gruppe
	I. Ökologische Gruppe der xerophilen Buchen-Hainbuchenwälder					
A_1	*Carpinus betulus* L.	3,0	+–2	IV	12	1
A_1	*Acer platanoides* L.	0,4	–+	III	2	1
A_2	*Acer platanoides* L.	0,3	–+	II	1	
A_1	*Prunus avium* L.	0,2	–+	I	—	1
C	*Dentaria bulbifera* L.	5,3	+–3	IV	21	2
C	*Hedera helix* L.	1,0	+–1	III	3	3
C	*Melica uniflora* Retz.	0,3	–+	II	1	1
C	*Viola alba* Bess.	0,3	–+	II	1	2
C	*Lilium martagon* L.	0,2	–+	I	1	1
C	*Galium silvaticum* L.	0,1	+	+	—	3
C	*Stellaria holostea* L.	0,1	+	+	—	3
C	*Lathyrus vernus* (L.) Bernh.	0,1	+	+	—	2
C	*Glechoma hederacea* L.	0,1	+	+	—	3
	II. Ökologische Gruppe des mesophilen Buchen-Hainbuchenwaldes					
A_1	*Fagus silvatica* L.	47,5	2–5	V	238	4
A_2	*Fagus silvatica* L.	0,7	+–2	II	2	
B	*Corylus avellana* L.	0,5	–+	III	2	5
B	*Daphne laureola* L.	0,3	+–1	II	1	5
C	*Galium odoratum* (L.) Scop.	4,2	+–2	V	21	4
C	*Viola silvestris* Lam. em. Rchb.	0,3	–+	II	1	4
C	*Mycelis muralis* (L.) Dum.	0,3	–+	II	1	5
C	*Geranium Robertianum* L.	0,1	+	+	—	5
C	*Dactylis polygama* Horvátovszky	0,1	+	+	—	5
C	*Fragaria vesca* L.	0,1	+	+	—	5
C	*Ajuga reptans* L.	0,1	+	+	—	5
C	*Euphorbia amygdaloides* L.	0,1	+	+	—	4
	III. Ökologische Gruppe des subhygrophilen Buchen-Hainbuchenwaldes					
B	*Cornus sanguinea* L.	0,3	+–2	III	3	6
C	*Allium ursinum* L.	31,2	+–5	V	156	10
C	*Galeobdolon luteum* L.	7,9	+–3	V	40	7
C	*Corydalis cava* Schw. et K.	5,5	+–2	V	28	10
C	*Galanthus nivalis* L.	1,0	+–1	IV	4	7
C	*Asarum europaeum* L.	0,3	–+	II	1	7
C	*Arum maculatum* L.	0,2	–+	I	1	10
C	*Anemone ranunculoides* L.	0,2	–+	I	1	10
C	*Corydalis solida* Schwartz.	0,2	–+	I	1	10
C	*Lamium maculatum* L.	0,2	–+	I	1	7
C	*Aegopodium podagraria* L.	0,2	–+	I	1	8
C	*Isopyrum thalictroides* L.	0,1	+	+	—	10
C	*Adoxa moschatellina* L.	0,1	+	+	—	10
C	*Geum urbanum* L.	0,1	+	+	—	6
C	*Prunella vulgaris* L.	0,1	+	+	—	6
C	*Senecio nemorensis* L.	0,1	+	+	—	8
C	*Hypericum perforatum* L.	0,1	+	+	—	6
C	*Galeopsis pubescens* Bess.	0,1	+	+	—	6

Tabelle 7 (Fortsetzung)

Schicht	Pflanzenart	$\bar{D}$	A–D	K	$\bar{D} \cdot K$	Ökologische Gruppe
	IV. Ökologische Gruppe des hygro-nitrophilen Buchen-Hainbuchenwaldes					
B	*Sambucus nigra* L.	0,3	—+	II	1	9
C	*Chelidonium majus* L.	0,3	—+	II	1	9
C	*Atropa belladonna* L.	0,9	+—2	I	1	12
C	*Verbascum thapsus* L.	0,1	+	+	—	9
C	*Cirsium arvense* (L.) Scop.	0,1	+	+	—	9
C	*Urtica dioica* L.	0,1	+	+	—	9
	V. Ökologische Gruppe der hygrophilen, montanen Buchenwälder und Schluchtwälder					
A_1	*Taxus baccata* L.	16,3	+—4	V	82	22
B	*Taxus baccata* L.	1,5	+—2	(III)	5	
A_1	*Acer pseudo-platanus* L.	0,3	—+	II	1	11
C	*Mercurialis perennis* L.	4,4	+—2	V	22	11
C	*Dentaria enneaphyllos* L.	8,0	+—3	IV	32	22
C	*Glechoma hirsuta* W. et K.	0,7	+—1	II	2	11
	VI. Ökologische Gruppe der xero-basiphilen Eichenwälder					
A_1	*Fraxinus excelsior* L.	6,3	+—3	V	32	21
A_2	*Fraxinus excelsior* L.	0,3	—+	II	1	
A_1	*Tilia platyphyllos* Scop.	1,2	+—2	III	4	21
A_1	*Fraxinus ornus* L.	0,3	—+	II	1	14
A_1	*Sorbus torminalis* (L.) Cr.	0,3	—+	II	1	16
A_1	*Quercus pubescens* Willd.	0,1	+	+	—	14
A_2	*Malus silvestris* Mill.	0,1	+	+	—	16
B	*Cornus mas* L.	0,8	+—2	III	3	21
B	*Staphylea pinnata* L.	0,1	+	+	—	21
B	*Rosa canina* L.	0,1	+	+	—	13
C	*Smyrnium perfoliatum* L.	0,9	+—2	I	1	21
C	*Polygonatum odoratum* (L.) Druce	0,2	—+	I	1	15
C	*Veratrum nigrum* L.	0,1	+	+	—	16
C	*Euphorbia cyparissias* L.	0,1	+	+	—	14
C	*Galium mollugo* L.	0,1	+	+	—	14
B	*Rosa canina* L.	0,1	+	+	—	13
C	*Smyrnium perfoliatum* L.	0,9	+—2	I	1	21
C	*Polygonatum odoratum* (L.) Druce	0,2	—+	I	1	15
C	*Veratrum nigrum* L.	0,1	+	+	—	16
C	*Euphorbia cyparissias* L.	0,1	+	+	—	14
C	*Galium mollugo* L.	0,1	+	+	—	14
	VII. Ökologische Gruppe der meso-neutrophilen Eichenwälder					
A_1	*Acer campestre* L.	3,5	+—2	IV	14	17
A_2	*Acer campestre* L.	0,3	+	III	1	
A_1	*Quercus cerris* L.	1,9	+—2	II	4	17
A_1	*Quercus petraea* (Matt.) Lieblein	0,1	+	+	—	18
A_1	*Ulmus minor* Mill.	0,1	+	+	—	17
A_2	*Pyrus pyraster* Burgsdorf	0,1	+	+	—	17
B	*Viburnum opulus* L.	0,1	+	+	—	19

Tabelle 7 (Fortsetzung)

Schicht	Pflanzenart	$\bar{D}$	A–D	K	$\bar{D} \cdot K$	Ökologische Gruppe
C	*Veronica chamaedrys* L.	0,2	–+	I	—	17
C	*Arabis turrita* L.	0,2	–+	I	—	17
C	*Convallaria majalis* L.	0,8	2	+	1	19
C	*Primula veris* L. em. Huds.	0,1	+	+	—	17
C	*Melittis grandiflora* SM.	0,1	+	+	—	17
C	*Viola hirta* L.	0,1	+	+	—	18
C	*Viola odorata* L.	0,1	+	+	—	19
	VIII. Ökologische Gruppe der azidophilen, xero-mesophilen Wälder					
C	*Veronica officinalis* L.	0,1	+	+	—	23
	IX. Ökologische Gruppe der einjährigen (Robinien) Arten					
C	*Alliaria petiolata* (MB.) Cav. et Grande	0,1	+	+	—	16

Zahl der aufgenommenen Parzellen:		12
Höhe über dem Meeresspiegel:		429,2 (360—490) m
Neigungswinkel:		19,4 (1—40)
Durchschn. Baumbestand:		175,3 m^3/ha
Holzertragsklasse:		6,0 (VI)
Facies: *Allium ursinum*		75,0%
Mercurialis perennis		17,0%
Galeobdolon luteum		8,0%
Durchschnittswert der Deckung:	A_1-Schicht	65,8%
	A_2-Schicht	18,2%
	B-Schicht	7,5%
	C-Schicht	76,3%

vorherrschen. Außer den *Fagetalia*-Elementen kommen bereits viele *Quercetalia*- und *Epilobietalia*-Arten vor.

Aufgrund der zönologisch-ökologischen Artengruppen sind die subhygrophilen und hygrophil-nitrophilen Buchen-Hainbuchenwaldarten kennzeichnend.

Der synökologische Charakter der Assoziation wird von subhygrophilen, basiklinen und stark nitrophilen Pflanzen bestimmt.

F) **Fago-Ornetum, (hungaricum)** Zólyomi 1954, 1958.

Eine azonale Assoziation der Blumeneschen-Buchen-Karstwälder, auf unserem Gebiet zeigt sie das Anfangsstadium der Waldentwicklung. Auf den dolomitschotterigen Blöcken der Nordseiten, auf ihren vorspringenden trockenen Rücken und auf den flachgründigen schutthaltigen Gerüstböden kann sich nur diese Pionierholzvegetation entwickeln. Zwischen den dunstigen, nördlich gelegenen Buchenwäldern entstanden lokalisch verhältnismäßig warme und trockene Verhältnisse.

Den Charakter der Assoziation bestimmen die xerobasiphilen Eichenwälder und die subhygrophilen Buchenwälder der kühlen Nordseiten. Die Karstwaldassoziation ist eine typi-

Abb. 10. Typische, verzwergte Eiben der felsig-steinigen Gerüstböden der an *Carex alba*-reichen Karstwälder

sche Waldgesellschaft der *Orno-Cotinetalia*-Vegetation der südlichen, illyrischen Regionen. In Ungarn zeigt sie eine derartige Ausdehnung nur an wenigen Stellen; sie tritt auf unserem Gebiet an 22 Stellen auf.

Die Assoziation ist höchst artenreich; sie besteht aus 126 Arten, von denen die Zahl der Holzarten 18, die der Straucharten dagegen 16 ausmacht. Unter den Baumarten herrschen

die Buche (*Fagus silvatica*), die Blumenesche (*Fraxinus ornus*) und die Eibe (*Taxus baccata*) vor. Kennzeichnend ist außerdem das Auftreten von *Quercus cerris*, *Quercus pubescens*, *Tilia platyphyllos* und *Acer platanoides*. Vereinzelt ist noch *Sorbus torminalis*, *Sorbus aria*, *Acer campestre*, *Carpinus betulus*, usw. vorzufinden. Die artenreiche Strauchschicht wird von solchen submediterranen Straucharten gebildet, wie *Viburnum lantana*, *Cornus mas*, *Cornus sanguinea*,
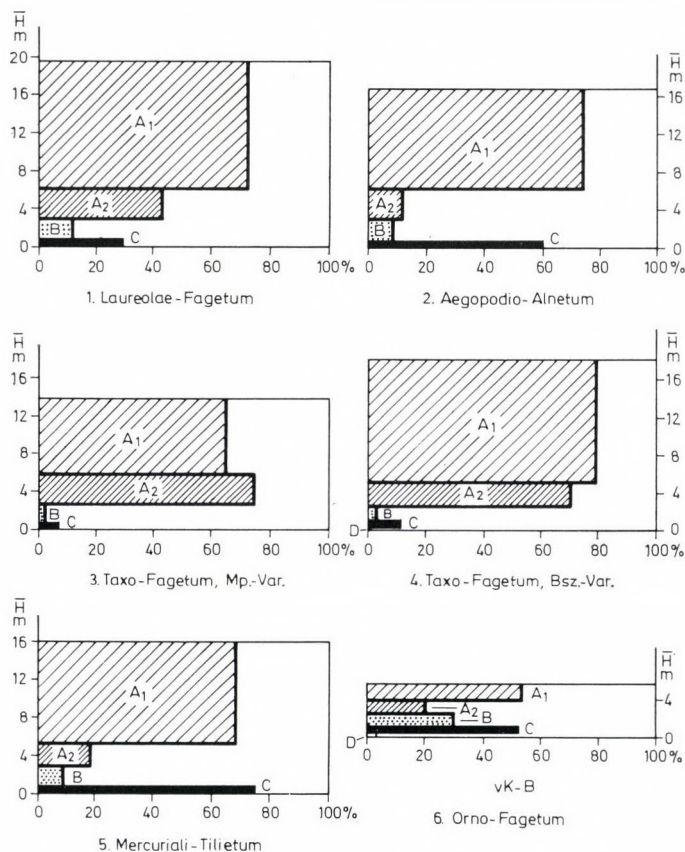
Abb. 11. Durchschnittliche prozentuale Deckung nach den Schichten und Baumhöhen der Pflanzenassoziationen: A_1 = obere Laubkronenschicht, A_2 = untere Laubkronenschicht, B = Strauchschicht, C = Rasenschicht, D = Moosschicht (die Höhe wurde aufgrund der Durchschnittsbäume der Modellfläche angegeben)

Lonicera xylosteum, *Rosa arvensis*, *Rhamnus catharticus*, *Colutea arborescens*, *Daphne laureola*, usw.

In der Rasenschicht sind *Carex alba*, *Calamagrostis varia*, sowie *Mercurialis ovata* und stellenweise *Melica uniflora* faziesbildend.

Die Waldassoziation ist äußerst heterogen; es herrschen die submediterranen *Quercetalia*-Elemente bereits vor, außerdem sind noch viele *Orno-Cotinetalia*-Arten vorzufinden.

Aufgrund des zönologischen Charakters kann sie ebenfalls mit den Arten der xerophil-basiphilen Eichenwälder und der mesophil-nitrophilen Eichenwälder gekennzeichnet werden,

auch azidophile Pflanzen kommen häufig vor, während auf dem Gebiet die Hemikryptophyten dominieren.

In synökologischer Hinsicht ist für die Assoziation eine Zusammensetzung aus subxerophiler, basiphiler und mäßig nitrogenbeanspruchender Vegetation kennzeichnend.

HOLZARTEN	1. Laureolae--Fagetum	2. Aegopodio--Alnetum	3. Taxo-Fagetum Mp.v.	4. Taxo-Fagetum Bsz.v.	5. Mercuriali--Tilietum	6. Fago--Ornetum
Fagus silvatica						
Carpinus Betulus						+
Taxus baccata						
Fraxinus ornus				++	++	
Fraxinus excelsior			+	++		+
Tilia plathyphyllos	++	+		+		
Tilia cordata	+					+
Acer compestre			+	+		+++
Acer platanoides	++	++	+		+++	++++
Acer-pseudo-Platanus		+++	+	+	++	+
Alnus glutinosa		+				
Ulmus minor					+	
Ulmus glabra	++		+			+
Quercus cerris		+	+	+	++	
Quercus pubescens	+				+	
Quercus petraea	+				+	+
Sorbus torminalis			+	+		+++
Sorbus aria						+
Prunus avium	++	+	+		+	
Pyrus pyraster					+	++
Malus silvestris					+	+
D̄K	0 25 50	0 25 50	0 25 50	0 25 50	0 25 50	0 25 50 %

Abb. 12. Vorkommen der Baumarten und Massenverhältnis in Prozentwert, je Assoziationen (+ bedeutet den Konstanzwert dort, wo kein Massenverhältniswert zur Verfügung steht)

Über die Deckungsverhältnisse der einzelnen Schichten der Assoziation, sowie über die Höhenentwicklung der Holzarten gibt Abb. 11 einen guten Überblick. Die Massenverhältnisse — je Assoziationen — der Baumarten, Straucharten und wichtigeren Krautarten wurden auf Abbildungen 12, 13 und 14 dargestellt.

Charakteristik der Bakonyer eibenreichen Buchenwalder (Taxo-Fagetum bakonyicum)

Aufgrund des Vergleichs der sechs Assoziationen ist die Eigenartigkeit der Bakonyer eibenreichen Buchenwälder äußerst hervorragend. Ihre Kennzeichen sind der Reihe nach:

STRÄUCHER	1. Laureolae-Fagetum	2. Aegopodio-Alnetum	3. Taxo-Fagetum Mp.v.	4. Taxo-Fagetum Bsz.v.	5. Mercuriali-Tilietum	6. Fage-Ornetum
Cornus mas				+		42
Cornus sanguinea		+	+	+		
Viburnum Lantana				+		
Viburnum Opulus	+				+	
Corylus Avellana						
Staphyllea pinnata				+	+	
Crataegus oxyacantha		+		+		
Crataegus monogyna		+		+		
Daphne Laureola						
Daphne Mezereum				+		
Euonymus verrucosus		+	+	+		
Euonymus europaeus	+	+		+		
Lonicera xylosteum						
Rosa arvensis				+		
Rosa canina					+	+
Berberis vulgaris						
Calutea arborescens						+
Rhamnus catharticus						+
Prunus spinosa						+
Sambucus nigra			+			
D̄.K.	0 10 20	0 10 20	0 10 20	0 10 20	0 10 20	0 10 20 %

Abb. 13. Vorkommen der Sträucher und ihr Massenverhältniswert (D̄ · K), je Assoziationen (+ = Konstanzwert)

1. Die eibenreichen Buchenwälder treten im unteren, nördlich-nordöstlich exponierten Teil des sehr steilen oberen Drittels des Szentgáler-Gebirges, besonders auf dolomitschutthaltigem, braunem Rendzinaboden, seltener auf schwarzem Rendzina- und Gerüstboden auf.

2. Der eibenreiche Buchenwald ist eine selbständige, sehr artenarme und eine homogene, spezielle Zusammensetzung und Physiognomie zeigende Assoziation. In der Laubkronenschicht ist die Buche (*Fagus silvatica*) und darunter die immergrüne Eibe (*Taxus baccata*) vorherrschend. Die Vegetation der Strauch- und Krautschicht ist demnach äußerst spärlich.

3. Typische Begleitholzarten sind *Fraxinus ornus*, *Tilia platyphyllos*, *Acer platanoides*, seltener *Acer campestre* und *A. pseudo-platanus*, *Quercus cerris* und *Sorbus torminalis*. Das Auftreten dieser Begleitarten ist jedoch dermaßen vereinzelt, daß sie im Mischverhältnis keine Rolle spielen, worauf die Abbildungen 15 und 16 verweisen.

4. Für die Strauchschicht des eibenreichen Buchenwaldes ist die immergrüne, ausgeglichene Verhältnisse bevorzugende, atlantisch-mediterrane Art
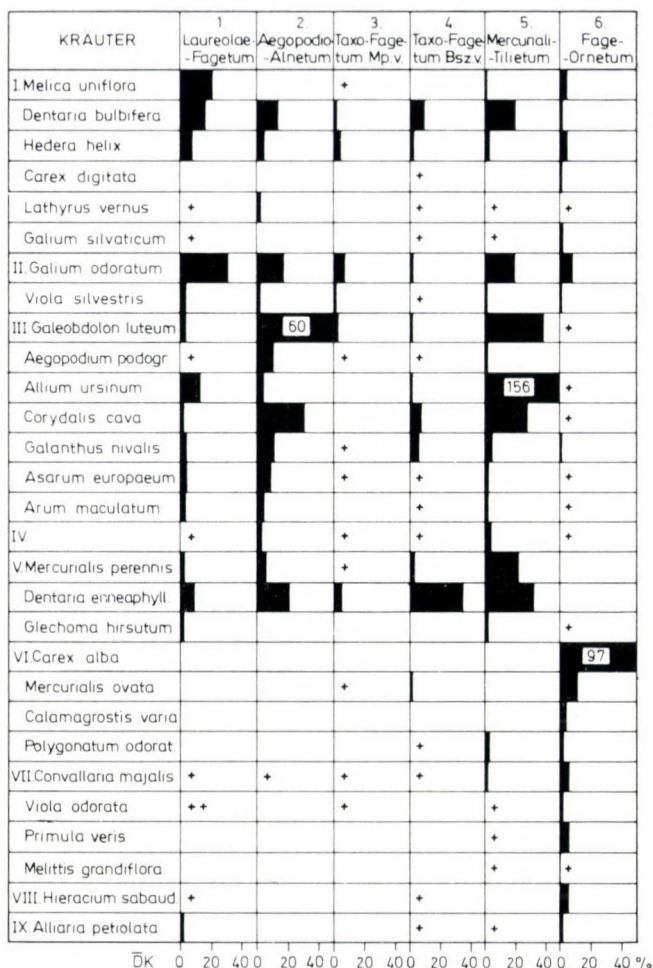
Abb. 14. Vorkommen und Massenverhältnis der wichtigeren Krautarten der einzelnen Assoziationen aufgrund der zönologischen Artengruppen (+ = Konstanzwert, wo kein Massenverhältniswert zur Verfügung steht)

Daphne laureola am meisten charakteristisch, es treten aber auch andere submediterranartige Sträucher, wie z. B. *Cornus mas*, *Cornus sanguinea*, *Euonymus verrucosus*, *Lonicera xylosteum*, *Rosa arvensis*, usw. auf.

5. Die Krautschicht ist im allgemeinen nudum; auch der Frühlingsaspekt ist fleckig. Kennzeichnend ist das Vorkommen von aus dem illyrischen Bergland stammendem *Dentaria enneaphyllos*, *Galium odoratum* und *Hedera helix*. Das fleckenhafte Auftreten einiger Geophyten ist vor allem für den Eiben-Buchenwald des Balogszeg-Berges charakteristisch; solche sind *Corydalis cava* und *Galanthus nivalis*.

Tabelle 8

Assoziation 6.: Pflanzenarten des Karstwaldes Fago-Ornetum (hungaricum)
Zólyomi 58

Schicht	Pflanzenart	$\bar{D}$	A—D	K	$\bar{D} \cdot K$	Ökologische Gruppe
	I. Ökologische Gruppe des xerophilen Buchen-Hainbuchenwaldes					
A_1	*Acer platanoides* L.	0,6	—+	IV	3	1
A_1	*Carpinus betulus* L.	0,1	+	I	—	1
B	*Carpinus betulus* L.	0,1	+	(+)	—	1
A_1	*Tilia cordata* Mill.	0,1	+	+	—	2
B	*Lonicera xylosteum* L.	0,9	+—1	III	3	1
C	*Hedera helix* L.	0,9	+—1	V	5	3
C	*Galium silvaticum* L.	0,6	—+	IV	3	3
C	*Campanula trachelium* L.	0,6	—+	IV	3	3
C	*Melica uniflora* Retz.	1,7	+—2	III	5	1
C	*Lilium martagon* L.	0,6	+—1	III	2	1
C	*Carex digitata* L.	1,1	+—1	II	3	2
C	*Dentaria bulbifera* L.	2,7	2	I	3	2
C	*Lathyrus vernus* (L.) Bernh.	0,5	—+	III	2	2
C	*Lathyrus venetus* (Mill.) Wohlf.	0,2	—+	I	—	2
C	*Viola alba* Bess.	0,1	+	+	—	2
	II. Ökologische Gruppe des mesophilen Buchen-Hainbuchenwaldes					
A_1	*Fagus silvatica* L.	30,0	2,3	V	150	4
B	*Fagus silvatica* L.	0,9	0,7	II	1	4
B	*Crataegus oxyacantha* L.	0,8	—+	V	4	5
B	*Corylus avellana* L.	0,9	2	I	1	5
B	*Daphne laureola* L.	0,9	2	I	1	4
C	*Euphorbia amygdaloides* L.	0,5	—+	IV	2	4
C	*Galium odoratum* (L.) Scop.	4,5	+—3	II	9	4
C	*Viola silvestris* Lam. em. Rchb.	0,3	—+	II	1	4
C	*Fragaria vesca* L.	0,4	—+	II	1	5
C	*Dactylis polygama* Horvátovszky	0,3	—+	II	1	5
C	*Ajuga reptans* L.	0,2	—+	I	—	5
	III. Ökologische Gruppe des subhygrophilen Buchen-Hainbuchenwaldes					
A_2	*Cornus sanguinea* L.	0,5	+—1	I	1	6
B	*Cornus sanguinea* L.	2,4	+—2	II	5	6
B	*Crataegus monogyna* Jacq.	0,4	—+	II	1	6
C	*Galanthus nivalis* L.	0,5	+—1	II	1	7
C	*Corydalis cava* Schw. et K.	0,2	—+	I	—	10
C	*Clematis vitalba* L.			I		
C	*Galeobdolon luteum* L.	0,2	—+	I	—	7
C	*Lamium maculatum* L.	0,2	—+	I	—	7
C	*Asarum europaeum* L.	0,1	+	+	—	7
C	*Arum maculatum* L.	0,1	+	+	—	10
C	*Anemone ranunculoides* L.	0,1	+	+	—	10
C	*Allium ursinum* L.	0,1	+	+	—	10
C	*Geum urbanum* L.	0,1	+	+	—	6
C	*Silene vulgaris* (Moench) Garcke	0,1	+	+	—	6
	IV. Ökologische Gruppe des hygro-nitrophilen Buchen-Hainbuchenwaldes					
C	*Chelidonium majus* L.	0,2	—+	I	—	9
C	*Galium aparine* L.	0,1	+	+	—	9

Tabelle 8 (Fortsetzung)

Schicht	Pflanzenart	$\bar{D}$	A–D	K	$\bar{D} \cdot K$	Ökologische Gruppe
	V. Ökologische Gruppe der hygrophilen, montanen Buchenwälder und Schluchtwälder					
F_1	*Taxus baccata* L.	19,5	+−3	V	98	22
B	*Taxus baccata* L.	1,6	+−2	*L*	8	22
F_1	*Acer pseudo-platanus* L.	0,1	+	+	—	11
B	*Ulmus glabra* Huds.	0,1	+	+	—	11
C	*Glechoma hirsuta* W. et K.	0,1	+	+	—	11
C	*Polypodium vulgare* L.	0,1	+	+	—	11
	VI. Ökologische Gruppe der xero-mesophilen Eichenwälder					
A_1	*Fraxinus ornus* L.	12,1	+−3	V	61	14
B	*Fraxinus ornus* L.	2,4	+−2	IV	10	14
A_1	*Tilia platyphyllos* Scop.	2,9	+−2	V	15	21
B	*Tilia platyphyllos* Scop.	0,2	−+	+	—	21
A_1	*Quercus pubescens* Willd.	1,0	+−1	IV	4	14
Aj	*Sorbus torminalis* (L.) Cr.	0,6	−+	III	2	16
B	*Sorbus torminalis* (L.) Cr.	0,1	+	+	—	16
A	*Sorbus aria* (L.) Cr. ssp. *cretica* (Lindl.) Soó	0,2	−+	I	—	21
B	*Sorbus aria* (L.) Cr. ssp. *cretica* (Lindl.) Soó	0,3	−+	II	1	21
A_1	*Fraxinus excelsior* L.	0,1	+	+	—	21
B	*Fraxinus excelsior* L.	0,1	+	+	—	21
A_2	*Malus silvestris* Mill.	0,1	+	+	—	16
B	*Euonymus verrucosus* Scop.	0,8	−+	V	4	15
B	*Cornus mas* L.	3,0	+−2	V	15	14
B	*Rosa arvensis* Huds.	0,6	−+	III	2	13
B	*Berberis vulgaris* L.	0,5	−+	III	2	15
B	*Staphylea pinnata* L.	2,1	+−2	II	4	21
B	*Rosa canina* L.	0,2	−+	I	—	13
B	*Prunus spinosa* L.	0,1	+	+	—	16
B	*Colutea arborescens* L.	0,1	+	+	—	14
B	*Rhamnus catharticus* L.	0,1	+	+	—	15
C	*Carex alba* Scop.	10,3	+−3	V	97	21
C	*Mercurialis ovata* Sternb. et Hoppe	3,6	+−2	III	11	15
C	*Euphorbia cyparissias* L.	0,5	−+	III	2	14
C	*Galium mollugo* L.	0,3	−+	II	1	14
C	*Polygonatum odoratum* (Mill.) Druce.	0,3	−+	II	1	15
C	*Vincetoxicum hirundinaria* Med.	0,3	−+	II	1	15
C	*Calamagrostis varia* Host	2,7	−2	I	3	27
C	*Coronilla emerus* L.	0,2	−+	I	—	13
C	*Teucrium chamaedrys* L.	0,2	−+	I	—	15
C	*Brachypodium pinnatum* (L.) P.B.	0,9	2	I	1	14
C	*Origanum vulgare* L.	0,2	−+	I	—	15
C	*Cardaminopsis arenosa* (L.) Hayek	0,2	−+	I	—	21
C	*Asplenium trichomanes* L.	0,2	−+	I	—	21
C	*Achillea millefolium* L.	0,1	+	+	—	14
C	*Fragaria viridis* Duch.	0,1	+	+	—	15
C	*Laser trilobum* (L.) Borkh.	0,1	+	+	—	15
C	*Coronilla varia* L.	0,1	+	+	—	15
C	*Turritis glabra* L.	0,1	+	+	—	14
C	*Viola ambigua* W. et K.	0,1	+	+	—	13

Tabelle 8 (Fortsetzung)

Schicht	Pflanzenart	$\bar{D}$	A–D	K	$\bar{D} \cdot K$	Ökologische Gruppe
	VII. Ökologische Gruppe der meso-neutrophilen Eichenwälder					
A_1	*Acer campestre* L.	0,3	—+	III	1	17
B	*Acer campestre* L.	0,4	—+	II	1	17
A_1	*Quercus cerris* L.	3,1	+—3	III	10	17
A_1	*Quercus petraea* (Matt.) Lieblein.	0,1	+	+	—	18
A_1	*Pyrus pyraster* Burgsdorf	0,1	+	+	—	17
B	*Pyrus pyraster* Burgsdorf	0,3	—+	II	1	17
C	*Primula veris* L. em. Huds.	1,1	+—1	IV	5	17
C	*Campanula persicifolia* L.	0,6	—+	IV	3	18
C	*Convallaria majalis* L.	1,6	+—2	III	5	19
C	*Tanacetum corymbosum* (L.) Schultz	0,5	—+	III	2	18
C	*Arabis turrita* L.	0,5	—+	III	2	18
C	*Veronica chamaedrys* L.	0,4	—+	II	1	17
C	*Viola odorata* L.	0,3	—+	II	1	19
C	*Viola hirta* L.	0,2	—+	I	—	18
C	*Poa nemoralis* L.	1,0	+—2	I	1	17
C	*Melittis grandiflora* SM.	0,2	—+	I	—	17
C	*Clinopodium vulgare* L.	0,2	—+	I	—	17
C	*Hypericum montanum* L.	0,2	—+	I	—	17
C	*Hypericum hirsutum* L.	0,1	+	+	—	17
C	*Astragalus glycyphyllos* L.	0,1	+	+	—	17
	VIII. Ökologische Gruppe der azidophilen, xero-mesophilen Wälder					
C	*Hieracium sylvaticum* (L.) L.	0,5	—+	III	2	23
C	*Hieracium sabaudum* L.	0,5	—+	III	2	23
C	*Hieracium pilosella* L.	0,3	—+	II	1	23
C	*Campanula rotundifolia* L.	0,2	—+	I	—	24
C	*Solidago virgaurea* L.	0,1	+	+	—	23
C	*Viola rupestris* F. W. Schm.	0,1	+	+	—	25
C	*Carlina vulgaris* L.	0,1	+	+	—	24
	IX. Ökologische Gruppe der einjährigen (Robinien) Arten					
C	*Alliaria petiolata* (MB.) Cav. et Grande	0,4	—+	II	1	26

Zahl der Aufnahmeparzellen:	11
Höhe über dem Meeresspiegel:	370,9 (320—420) m
Durchschn. Neigungswinkel:	41,4 (20—80)
Durchschn. Baumbestand:	56,8 m³/ha
Durchschn. der Holzertragsklasse:	8,5 (VIII—IX)
Facies: *Carex alba*	72%
Melica uniflora	18%
Carex digitata	10%
Deckung: A_1-Schicht	52,7
A_2-Schicht	20,2
B-Schicht	30,5
C-Schicht	50,0
D-Schicht	2,7

6. Im eibenreichen Buchenwald herrschen eher die mitteleuropäischen, atlantisch-mediterranartigen *Fagetalia*-Elemente vor. Typisch ist aber auch das Erscheinen von *Cephalanthero-Fagion*- und *Orno-Cotinetalia*-Elementen.
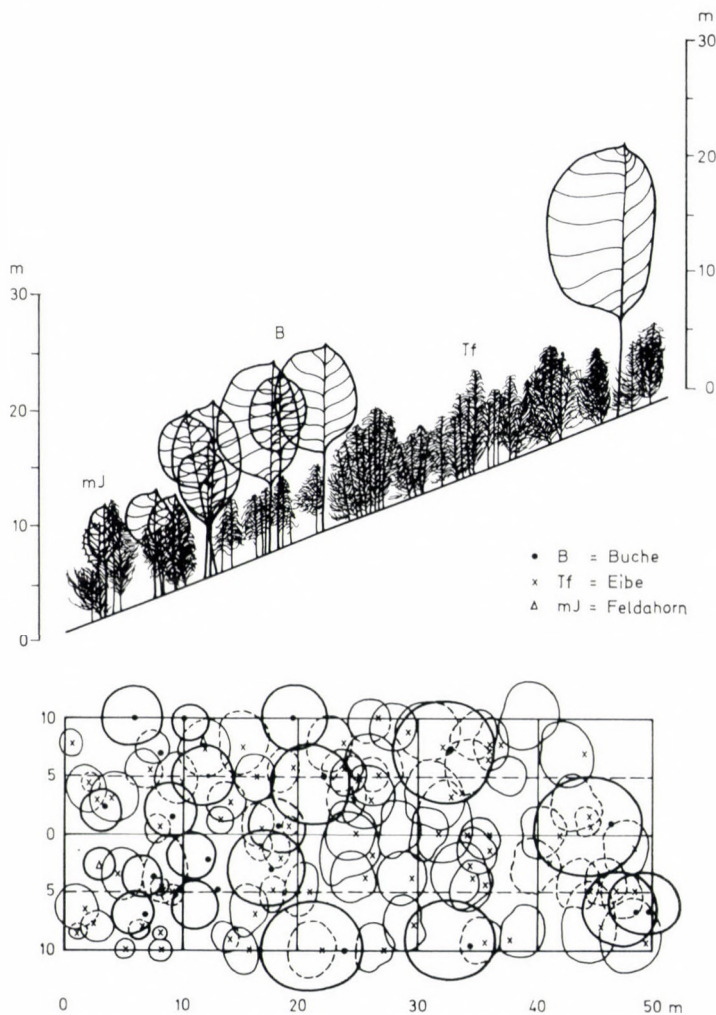
Abb. 15. Querschnitt und Projektionsgerippzeichnung des Holzbestandes des eibenreichen Buchenmustergebietes auf dem Miklóspál-Berg

7. Die Assoziation ist ausdrücklich von montanem Charakter; sie besteht aus den Buchenelementen der montanen und hygrophilen Wälder, sowie aus den Elementen der mesophilen Buchen-Hainbuchenwälder. Es ist für sie das Übergewicht der Holzpflanzen, in der Krautschicht dagegen größtenteils das Auftreten von Hemikryptophyten kennzeichnend.

8. Auf die synökologischen Verhältnisse verweist, im allgemeinen die subhygrophile, eher basiphile und weniger nitrophile Vegetation.

9. Die eibenreichen Buchenwälder stehen sowie in ökologischer Hinsicht, wie auch aufgrund ihrer Zusammensetzung zwischen dem azonalen, illyrischen *Fago-Ornetum*-Karstbuschwald und dem extrazonalen, submediterranartigen
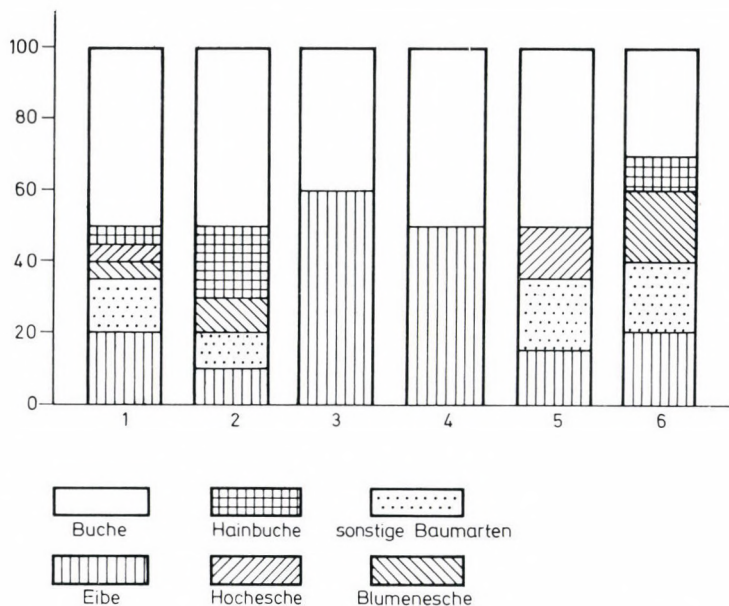
Abb. 16. Mischverhältnis der Holzarten der 6 Waldassoziationen (%)

Laureolae-Fagetum-Buchen-Hainbuchenwald. Sie sind demnach infolge edaphischer und mesoklimatischer Wirkungen entstandene intrazonale Übergangsassoziationen, »Dauerwaldgesellschaften«. In floristischer und synökologischer Hinsicht sind die 3 Waldgesellschaften miteinander ziemlich eng verknüpft, von physiognomischem Gesichtspunkt aus betrachtet weichen sie voreinander — wegen der immergrünen Schicht und des ständig geschlossenen Charakters der Eibe — völlig ab. Es ist also wohlbegründet, daß der Bakonyer eibenreiche Buchenwald als eine selbständige Assoziation betrachtet werden soll. Der Zusammenhang kommt auch auf Abb. 4 gut zum Ausdruck, da das Auftreten der Assoziation *Taxo-Fagetum bakonyicum* immer mit *Fago-Ornetum* und deren 22 felsigen, größtenteils Blöcke zeigenden Flecken verbunden ist.

10. Die Eibenassoziation ist also im Bakony-Gebirge eine natürliche Gesellschaft; auch im Laufe ihrer Analyse können wir zu der Feststellung gelangen, daß die Eibe auf diesem Gebiet autochton ist. Obwohl die Dolomit-Karstbuschwaldflecke im Bakony—Vértes-Gebirgszug auch anderswo vorkom-

men, sind ihre Wälder in einer derart großen Ausdehnung, wie im Szentgáler-Gebirge, nicht vorzufinden. Dazu aber, daß eine Holzpflanze in genetischer Hinsicht eine lebensfähige, dauerhafte Population bilden soll, ist die Ent-
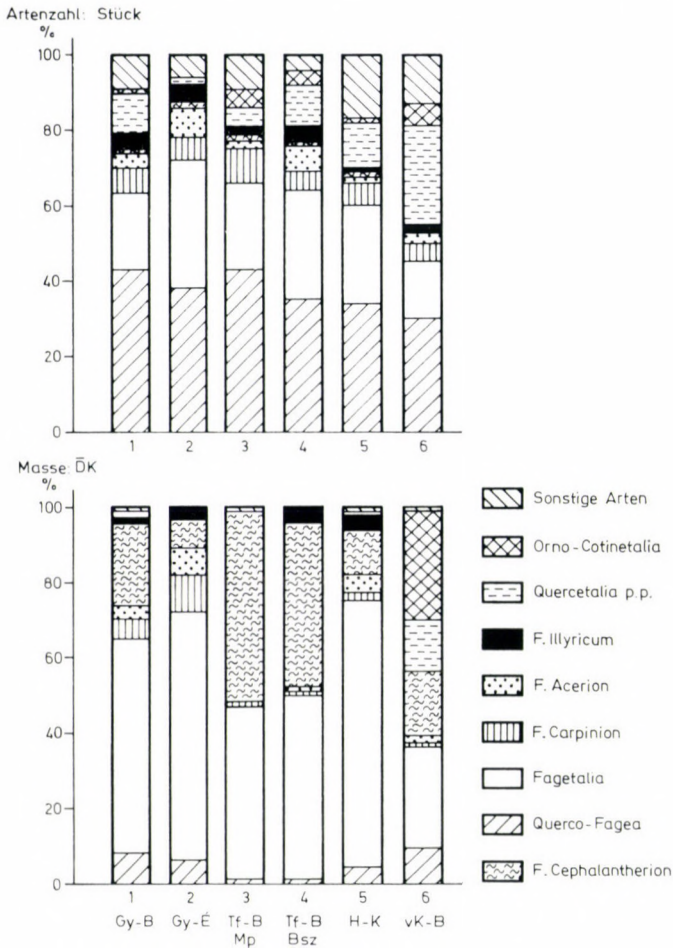
Abb. 17. Verteilung der zönologisch-ökologischen Kennzeichen aufgrund der Artenzahl (oben) und des Massenverhältnisses (unten)

wicklung von ein paar hundert Individuen mit männlichen und weiblichen Blüten nötig, und das bedeutet wenigstens ein Gebiet von 20—30 ha. Nur ein so großes Gebiet sichert eine entsprechende Möglichkeit zur Bestäubung und Samenverbreitung, und kann das natürliche Verjüngungsvermögen der Art entwickeln, sowie ein günstiges Wachstum und eine gute Entwicklung hervorrufen. Ein so günstiger Standort und ein derart entsprechend großes Gebiet ist heute nur im Szentgáler-Gebirgszug zu finden.

Tabelle 9

Zahl und Holzmaße der Eiben des eibenreichen Waldes von Bakony-Szentgál

Nr.	Waldassoziation	Fläche		Eibe auf 1 ha		Eiben insgesamt	
		%	ha	Stück	m³	1000 St.	m³
1	*Laureolae-Fagetum*	25	71,7	200	5,6	14,3	40
2	*Aegopodio-Alnetum*	20	57,5	+	+	0,8	4
3	*Taxo-Fagetum* Mp Var.	15	43,1	1260	93,6	54,3	403
4	*Taxo-Fagetum* Bsz Var.	15	43,1	570	20,4	24,6	88
5	*Mercuriali-Tilietum*	20	57,5	+	+	3,0	13
6	*Orno-Fagetum*	5	14,4	1600	36,0	23,0	52
Insgesamt:		100	287,3			120,0	600
Reduziertes Gebiet:			172,3			—	—
Durchschn. auf 1 ha:						0,7	3,5

11. Seit langem besteht eine Diskussion über die Frage der Zahl und Holzmasse der Eibe im Szentgáler Eibenvorkommen. Ohne die Kontroversen zu erwähnen, berufe ich mich darauf, dass ich bei drei Gelegenheiten Messungen durchgeführt habe b. Z. sie vornehmen ließ; diese führten jedesmal zu 120 000 Stück Eiben und zu einer Holzmasse von 600 m³ (s. Tabelle 9 !). Im Besitz dieser Daten kann festgestellt werden, daß der Szentgáler Eibenwald heute, in Hinsicht auf die Individuenzahl, der zweitgrößte eibenreiche Wald in Europa ist. Die 180 000 Stämme zählende Population im slowakischen Besztercebánya-Harmanec kommt zwar unserer Population zuvor, dort kommt jedoch die Eibe auf 3000 ha vor (Svoboda 1947, 1953, Tschmermák 1949, 1950, Rubner 1952, Hofman 1953, 1970, Zlatnik 1957, Korpel-Paule 1975, 1976). Im Bakony-Gebirge tritt sie auf 287 ha auf. Darum halten wir das Szentgáler Vorkommen in Betracht der Zahl der Eibenstämme auf einer Flächeneinheit auch heute noch für das bedeutendste eibenreiche Waldgebiet in Europa.

12. Die Flurnamen »Tiszás«, »Tiszaalji völgy«, sowie der Felsname »Tiszáskő« beweisen, daß die Eibe hier einheimisch war. Obige Benennungen kamen bereits im 18. Jahrhundert als geographische Ortsnamen vor. Unser mächtigster Eibenstamm zeigt in Brusthöhe einen Durchmesser von 48 cm, und obwohl die Eiben verhältnismäßig niedrige Bäume sind und kaum eine Höhe von 8 m erreichen, sind auf unserem Gebiet auch 12 m hohe Individuen zu treffen (s. Abb. 18, 19). Das Alter der mächtigen Bäume erreicht im allgemeinen 200—300 Jahre.

Abb. 18. Die grösste lebende Eibe; Stammdurchmesser in Brusthöhe 48 cm, ung. 100 Jahre alt

Daß die Eibe hier einheimisch ist, beweist auch der 1974 auf dem Balogszeg-Berg gefundene trockene Holzklotz, der in Brusthöhe einen Durchmesser von 65 cm zeigte und auf 600 Jahre alt geschätzt wurde. Der im 13. Jahrhundert lebende Mensch war auf diesem Gebiet mit seinem Unterhalt viel zu sehr beschäftigt, als daß er aus ästhetischen Gründen Eiben gezüchtet hätte.

Abb. 19. Die höchste Eibe (12 m) ist im *Galium odoratum* Buchen-Hainbuchenwald des Miklós-pál-Berges zu finden (nach Durchforstung)

Pflanzengeographische Charakterisierung des Bakonyer eibenreichen Buchenwaldes (seine Beziehung zu den wichtigeren Eibenvorkommen in Europa)

Die Eibe ist in ganz Europa aufzufinden. Ihre nörliche Verbreitungsgrenze läuft auf den Britischen Inseln, in Norwegen (nach verschiedenen Autoren in der Nordbreite von 61—63°) und auf den südlichen Gebieten (61°) von Schweden und Finnland; sie übergreift aber auch auf die Aland-Inseln. Die südliche Grenze ihres Areals führt durch die Halbinseln und Inseln der Länder am Mittelmeer, sie tritt aber auch in Nordafrika, Algerien, Kleinasien und auf den nördlichen (Pontus) und südlichen (Taurus) Randgebirgen der anatolischen Hochebene auf. Östlich zieht sich die Grenze der Eibe von der Bucht von Riga durch Bialowieza bis zu den Ostkarpaten, und von hier südöstlich bis zum Schwarzen Meer hin. Auf der Halbinsel Krim, im Kaukasus, sogar in den hohen Bergregionen des Kaspischen Meeres und auf dem iranischen Elburz ist sie zu treffen.

Innerhalb dieses verhältnismäßig ausgedehnten Areals fehlt sie in den vom kontinentalen Klima beeinflußten Gebieten, also in den östlichen Teilen Europas, in der anatolischen Hochebene und so auch in der Großen Ungari-
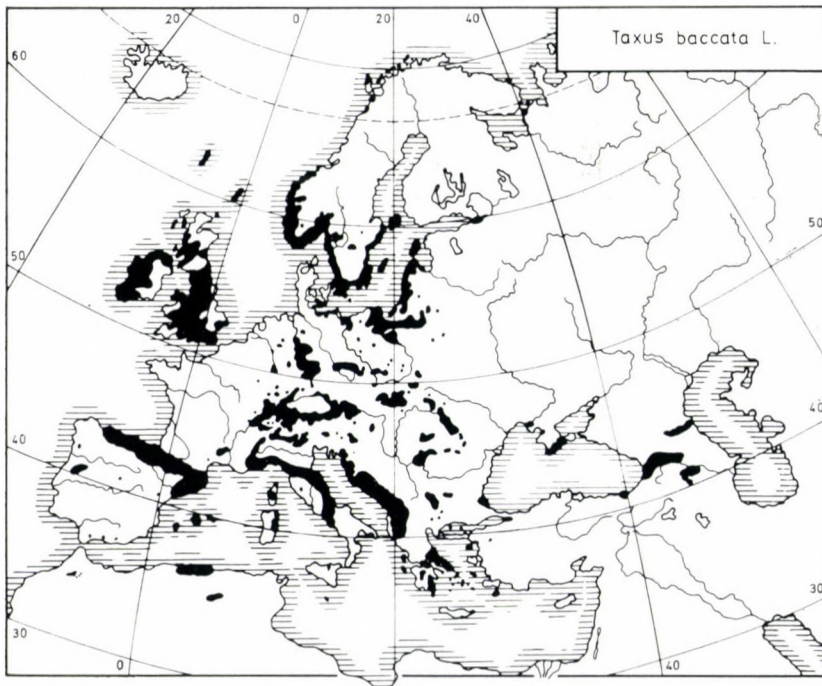
Abb. 20. Verbreitung der Eibe nach MEUSEL (1939) (in G. HOFMANN 1959)

Tabelle 10

Vergleich der Vegetation der eibenreichen Buchenwaldassoziationen

(a = atlantische, d = eher südlichere, k = eher östlichere, alp. = alpine, ti-B = eibenreiche Buchenwaldarten)

Nummer	1	2	3	4	3	6	7	8	9	10	11
Geographischer Ort:	Schweizer Mittel-Jura-Gebirge		DDR West-eichsfeld	DDR Meiningen	Slowakei Harmanec	Bakony Mph.	Bakony B. sz.	Kroatien Zágráber Geg. bis Kotár	Griechenland	Türkei Strandzsa Gebirge	Sran Elburz
Name des Autors: Jahr der Publikation:	Etter 1471	Moor 1521	G. Hofmann 1581		Majer 1751	Majer 1761		Glavac 1581	Dafis 1691	Stafanov (in I. Horvát–Glavac) 1741	Mossadegh 1711
Zahl der Aufnahmen: Stück	19	16	16	10	4	14	16	15	4	1	5
I. Charakter- und konstante Arten											
A *Taxus baccata* (a)	V	IV	V	V	5	V	V	V	2	5	5
II. Konstante Arten											
C *Galium odoratum*	II	V	V		+—1	IV	III	II	1	1	1—3
Hedera helix	V	I	V	V	+	IV	III	I	1—2		
III. Mitteleuropäische, ± Fagetalia—südwestliche Arten (1/3—8—9)											
A *Fagus silvatica* (a)	V	V	V	V	5	V	V	IV—V			
Abies alba (alp.)	V	V	I		1—4			III			
Acer platanoides			III	I	+—2	I	III	III	+		
B *Daphne mezerum*	V	III	V	V	+		I	IV			
Lonicera xylosteum			IV	V	—+		II	I			
Rosa arvensis (a)	IV	I			—+		+	IV			
C *Mercurialis perennis*	V	V	IV	V	1—2	+	III	V			
Carex digitata	V	III	IV	V			+	V			

	Lilium martagon	III	IV	I	III	—+		II	II			
	Phyteuma spicatum	IV	V	V	II			(+)	+			
	Knautia silvatica (*drymeia*)	V	V			—+	(+)		II			
	Carex alba (alp.) (*ornithopoda*)	III	IV			1—3	I	(V)				
	Calamagrostis varia (alp.)	V	V	I		+—2		(+)	II	—1		
	Prenanthes purpurea (alp.)	V	V			+			III			
	Lathyrus vernus (k)		II	V	III	—+		I	III			
	Convallaria majalis (k)		I	V	IV	—+	+	I	III			
	Hieracium sylvaticum (k)	IV	V	V	IV	+		(+)	V	+		

IV. Wie oben, nur südöstliche Arten (3—11)

A	*Carpinus betulus*			V	II			III	I	2	5	1—2
	Sorbus torminalis			V		+—1	+	I	II	+—1	1	—+
	Acer campestre			I	V			(+)	I		+	
C	*Cephalanthera rubra*			II	III			(+)		+		+
	Neottia nidus-avis (k)			II	+			+	—+		1	
	Campanula persicifolia (k)			II				(+)	I	—+	+	

V. Nur im Bakonyer eibenreichen Buchenwald auftretende Arten (6—7)

C	*Mercurialis ovata* (d)						+	II				
	Allium ursinum (a)							II				
	Corydalis cava							III				
	Galanthus nivalis						+	IV				
	Hieracium sabaudum (k)							+				

VI. Gemeinsame Arten obiger Wälder im Bakony und Kroatien (6—8)

A	*Quercus cerris* (d)						+	+	I			
	Quercus pubescens (d)							(+)	I			
	Quercus petraea (a)							(+)	I			
B	*Cornus mas* (d)							+	III			
	Euonymus verrucosus (d)						+	I	II			
	Staphylea pinnata (d)						(+)	(+)	III			
	Rhamnus catharticus (d)							(+)	III			
C	*Galium silvaticum* (a)							I	IV			

Tabelle 10 (Fortzetzung)

Nummer:	1	2	3	4	5	6	7	8	9	10	11
Geographischer Ort:	Schweizer Mittel-Jura-Gebirge		DDR West-eichsfeld	DDR Meiningen	Slowakei Harmanec	Bakony		Kroatien Zágráber Geb. bis Kotár	Griechenland	Türkei Strandzsa Gebirge	Sran Elburz
						Mph.	B. sz.				
Name des Autors: Jahr der Publikation:	Etter (47)	Moor (52)	G. Hofmank (58)		Majer (75)	Majer (76)		Glavac (58)	Dafis (69)	Stefanov (in J.Horvát–Glavac) (74)	Mossadegh (71)

VII. Gemeinsame Arten der eibenreichen Buchenwälder im Bakony, Kroatien und der DDR (4—8)

	1	2	3	4	5	6	7	8	9	10	11
A *Sorbus aria* (d)				V	+—1		(+)	V			
B *Viburnum lantana* (d)				IV	—+		+	II			
Corylus avellana				II	—+		(+)	III			
Cornus sanguinea				I		+	+	I			

VIII. Arten obiger Wäler im Bakony und auf dem Balkan (Griechenland) (6—9)

	1	2	3	4	5	6	7	8	9	10	11
A *Fraxinus ornus* (d)						IV	II	V	+—1		
B *Daphne laureola* (a)						IV		II	1		
C *Viola hirta* (d)							(+)		—+		
Lathyrus venetus (a)							(I)		+—1		
Tanacetum corymbosum (d)							(+)		—+		
Campanula trachelium (+k)				II	—+		+	III	+—1		
Primula veris (+k)				III			(+)		—+		

IX. Arten obiger Wälder im Bakony-Gebirge, der Türkei und Iran (6—11)

	1	2	3	4	5	6	7	8	9	10	11
B *Berberis vulgaris* (d)							(+)	+			—+
C *Arum maculatum*							(+)			+	
Aegopodium podagraria						(+)	(+)			+	
Viola odorata (a)							I				+—2
Poa nemoralis							(+)			+	+—2

X. Arten der eibenreichen Buchenwälder in den Karpaten, im Bakony und Kroatien (5—8)

A	*Sorbus aucuparia* (alp.)					+—1			II			
B	*Rubus idaeus* (alp.)					+			III			
C	*Dentaria enneaphyllos* (alp.)					1—3	IV	V	III			
	Asarum europaeum					—+	+	I	II			
	Cephalanthera longifolia					+		(+)	+			

XI. Arten obiger Wälder in der Karpaten, im Bakony, auf griechischen und türkischen Gebieten (5—10)

A	*Acer pseudoplatanus*					+—2	I	+	II		+	
	Tilia platyphyllos (d)				III		III	I	IV		+	
C	*Galeobdolon luteum*				II		III	III	III	—+		
	Viola silvestris					—+	III	I		—+		
	Senecio nemorensis + Fuchsii					—+			+		+	
	Dentaria bulbifera					+—2	II	V		(+)	+	

XII. Gemeinsame Arten der eibenreichen Buchenwälder der Karpaten, des Bakony und Irans (5—11)

A	*Fraxinus excelsior*					—+	I	II				—+
C	*Euphorbia amygdaloides*					—+	+	I	+	1	+	1—2
	Melica uniflora					—+	I		II	1—2	1	
	Mycelis muralis					+	I	I	V	+—1	+	
	Sanicula europaea					—+		+		—+		+—3
	Polygonatum multiflorum					+		(+)	II	+—1		+

Nur im Schweizer Mittelgebirge: *Lonicera alpigena, Tamus communis.*
Nur im Deutschen Mittelgebirge: *Epipactis atrorubens, Laserpitium latifolium.*
Nur in den Karpaten: *Picea abies, Vaccinium myrtillus, Vaccinium vitis-idea, Oxalis acetosella.*
Nur in Kroatien: *Cyclamen purpurascens.*
Nur in Griechenland: *Castanea vesca, Aesculus hyppocastanum, Acer obtusatum, Primula acaulis.*
Nur in der Türkei: *Rhododendron ponticum, Daphne pontica, Vaccinium arcto-staphyllos, Pyracantha coccinea.*
Nur in Kroatien und Griechenland: *Ostrya carpinifolia.*
Nur in Griechenland und der Türkei: *Ruscus aculeatus, Ruscus hypoglossum, Fagus orientalis.*
Nur in der Türkei und Iran: *Prunus laurocerasus, Euonymus latifolius, Carpinus orientalis.*
Gemeinsame Eiben-Buchenarten in den Karpaten und den Alpen: *Rosa pendulina, Sesleria varia, Polygonatum verticillatum*

schen Tiefebene. Eben deshalb kommt sie in den inneren, kontinentalen Teilen der Hochgebirgsregionen Mitteleuropas, also in den Zentralgebieten der Alpen und der Karpaten nicht vor. Im Norden und in den hochliegenden Regionen bedeuten die Kältewerte unter —30 °C, im Süden dagegen die lange Dürrezeit und die große Wärme einen unüberschreitbaren Schwellenwert. Sie bevorzugt die unter ozeanischer Klimawirkung stehenden Gebiete, die dunstig und von ausgeglicher Temperatur sind. Die Eibe ist höchst empfindlich gegen die niedrigen Temperaturen, wo sie nicht geschützt und im Schatten wächst, erfriert sie bald infolge der Winterkälte und der tockenen Winde. Es ist kein Zufall, daß die Ostgrenze ihres Areals mehr oder weniger mit der der Buche, im Südwesten dagegen mit der der Tanne zusammenfällt.

Innerhalb ihres Areals ist außerdem auffallend, daß sie in der Mittelmeergegend in hohen Gebirgsregionen, in Mitteleuropa in Gebirgsregionen, auf den nördlichen Gebieten dagegen in Tiefebenen wächst. In Nordafrika kommt sie bis 2500 m, in Kleinasien und auf der Krimhalbinsel bis 2300 m, im Kaukasus bis 2000 m, in Südspanien bis 1950 m, in den Pyrenäen bis 1630 m, in den Karpaten bis 1600 m, in den Alpen bis 1470 m vor, während sie in den mittelhohen Gebirgsregionen von Ungarn, Deutschland, der Tschechoslowakei, sowie von Polen auch 500—300 m über dem Meeresspiegel vorzufinden ist; gegen Norden tritt sie in immer niedrigerer Höhe auf, in den baltischen Staaten und im südlichen Teil von Skandinavien ist sie sogar annähernd in der Meereshöhe zu treffen.

Innerhalb ihres Areals tritt die Eibe in ziemlich isolierten Flecken auf, wie das auch auf der Arealkarte wahrzunehmen ist. Für ihr Vorkommen ist die vereinzelte oder gruppenartige Mischung charakteristisch; sie wächst meistens im Schutz der unteren Schicht von Buchenmischbeständen. Nur unter starker ozeanisch-atlantischer Klimawirkung, z. B. in England oder in den ostmediterranen Hochgebirgen, z. B. im Kaukasus oder in Iran bildet sie stellenweise auf kleineren Gebieten bestandesartige Flecke.

Innerhalb des Verbreitungsgebietes der Eibe können 11 solche typischen geographischen Regionen unterschieden werden, deren eibenreiche Wälder mit denen der Taxus-Wälder von Bakony-Szentgál wohl verglichen werden können. Im Rahmen der Beschreibung gehen wir aus dem Bakonyer Eibenwald aus, dann folgen die Karpaten, Alpen und das Deutsch-Böhmische Mittelgebirge, ferner werden — zum Zweck der Feststellung der pflanzengeographischen Verbindung — die südlichen Verbreitung zeigenden kroatischen, griechischen, türkischen und iranischen eibenreichen Wälder kurz charakterisiert (Tabelle 10). Außer den oben aufgezählten sind die Eibenwälder der Mittelmeergegend, wie z. B. die iberischen, italienischen und algerischen Bestände, sowie die Taxus-Wälder des Kaukasus und der Krimhalbinsel, bzw. die der nordeuropäischen Tiefebenen derart entfernt von dem Bakonyer Eibenwald, daß von ihrer eingehenden Beschreibung abgesehen werden kann. Die lokale

Tabelle 11

Die eibenreichen Waldassoziationen aufgrund ihrer geographischen Trennung

Nr., Name, Ort des Vorkommens und Assoziation (mit Synonymen)	Nummer der Säule in Tab. 10
1. Bakonyer Eibenwald (Szentgál) Taxo-Fagetum (Moor 52) bakonyicum, Majer 76 (+*Fago-Ornetum hungaricum*, Zólyomi 50 +*Laureolae-Fagetum*, Soó 71)	6—7
2. Karpatische Eibenwälder: Slowakei-Harmanec Taxo-Fagetum (Moor 52) carpaticum, Majer 75 ((»carpatica«, Svoboda 53) [*Taxeto-Fagetum* (Etter 47) J. Hofman 53] (*Fagetum dealpinum*, +*F. pauper*, +*F. typicum*, +*Tilieto-Aceretum*, Zlatnik 59)	5
3. Eibenwälder des Deutsch-Böhmischen Mittelgebirges Taxo-Fagetum (Moor 52) Haupt. ss. Seslerio-Taxetum G. Hofman 58 Reg. Ass. (+*Cephalanthero-Fagetum tilietosum*, +*Cephalanthero-Fagetum typicum*, +*Cephalanthero-Fagetum lithospermetosum*, +*Melico-Fagetum taxetosum*, G. Hofman 58)	3—4
4. Eibenwälder der Vorläufer der Alpen (+ Jura) Taxo-Fagetum, Moor 52 (*Taxeto-Fagetum* Etter 47) (»*praealpina*« Svoboda 53)	1—2
5. Kroatische Eibenwälder Tilieto-Taxetum, Glavac 52 (+*Calamagrostio-Abietum*, Horv. 50 *Taxeto-Fagetum croaticum* Horv. 50)	8
6. Griechische (balkanische) Eibenwälder Fagetum orientalis-submontanum taxetosum, Dafis 69 (»*balcanica*«, Svoboda 53)	9
7. Türkische Eibenwälder Taxo-Fagetum (Moor 52) (»*pontica*«, Svoboda 53) (+*Rhododendro pontici-Abieti-Fagetum orientalis*, Aksoy-Mayer 75)	10
8. Eibenwälder des Kaukasus, der Krimhalbinsel und von Iran Euonymo-Taxetum, Mossadegh 71 (*Acereto-Taxetum*, Djazirei 65, *Fagetum hyrcanum taxetosum*, Tregubov 66 »*caucasica*« »*taurica*«, Svoboda 53)	11
9. Iberische und italienische Eibenwälder Taxo-Fagetum (Moor 52) (»*hispanica*« »*appennina*«, Svoboda 53)	
10. Algerische Eibenwälder Taxo-Fagetum (Moor 52) (»*algerica*«, Svoboda 53)	
11. Eibenwälder der Tiefebenen Nordeuropas Cephalanthero-Fagetum balticum, G. Hofman 58 (»*hibernica*«, »*scandinavica*«, »*polonica*«, Svoboda 53) [+*Fagetum boreo-atlanticum* (Tx. 34), +*Fraxineto-Alnetum*, Matuskiewicz 52, +*Cariceto elongatae-Alnetum medioeuropaeum* (Tx. 55)]	—

und wissenschaftliche Benennung der 11 geographischen Vorkommen ist in einer grösseren vergleichenden Tabelle (Tabelle 11) angegeben.

Den Tabellen ist zu entnehmen, daß im Bakonyer eibenreichen Buchenwald das Auftreten südwestlicher, mitteleuropäischer Buchenarten (*Fagetalia*) bedeutend ist; in den Regionen 1—8 sind 19 Arten identisch. Noch stärker ist das Vorkommen von südlichen Florenelementen; in Kroatien verweisen 12 Arten, in Griechenland weitere 7 Arten, in der Türkei dagegen noch andere 5 Arten, insgesamt also 24 Pflanzenarten auf eine engere Verbindung. Wenn wir die Pflanzenarten von den Karpaten ausgehend betrachten, wird die Liste um weitere 11 Arten reicher. Es ist demnach interessant, daß der Bakonyer *Taxus*-Wald nicht mit den Eibenwäldern der näher liegenden Karpaten und Alpen, sondern mit den südlich liegenden kroatischen *Taxus*-Wäldern eine engere pflanzengeographische Verbindung aufweist, außerdem hat er mehrere gemeinsame Arten mit denen der griechischen, türkischen, kaukasischen und iranischen *Taxus*-Wälder.

Das Eibenvorkommen von Szentgál befindet sich annähernd in der Mitte des europäischen Areals und tritt auch hier, wie überall, in isolierten Flecken auf. Der Bakonyer *Taxus*-Wald liegt an der extremen Grenze seines Standortes, darum kann er auf bereits speziellem Boden, auf Dolomit und auf schutthaltigem, ziemlich basisreichem Rendzina, unter günstigen, lokalen Klimagegebenheiten leben.

Zusammenfassung

Die Eibe (*Taxus baccata* L.) ist eine »aussterbende«, aber jedenfalls im Rückgang begriffene Holzpflanze Europas; im Bakony-Gebirge wächst sie auf einer kleinen Fläche, alles in allem genommen, auf 287 ha und bildet ein edaphisches, mesoklimatisches Relikt. Die 120 000 Stämme umfassende Siedlung und ihre Holzmasse von etwa 600 m^3 bildet den größten Naturschutzhort der ungarischen Wälder.

Vorliegende Abhandlung analysiert aufgrund der Assoziationsaufnahmen von 66 Untersuchungsparzellen die 6 Gesellschaften des Gebietes, sie berichtet über ihr Erscheinen und ihre Verbreitung auf Karten und Querschnittsgrundrissen.

Der Bakonyer eibenreiche Buchenwald — *Taxo-Fagetum* Moor 52, *bakonyicum* Majer 76 — ist eine selbständige Assoziation; sie ist eine artenarme, homogene Waldgesellschaft von spezieller Zusammensetzung und einmaliger Physiognomie. Außer der Buche (*Fagus silvatica*) und Eibe (*Taxus baccata*) treten *Fraxinus ornus*, *Tilia platyphyllos*, *Acer platanoides* und seltener *Quercus cerris*, *Acer campestre* und *A. pseudo-platanus*, *Sorbus torminalis* nur als Begleitarten auf. Für ihre Strauchschicht ist das sporadische Vorkommen von *Daphne laureola*, und mehrerer submediterranartiger Straucharten charakteristisch.

Die Rasenschicht ist nudum. Eine kennzeichnende und häufige Pflanze des Frühlingsaspekts ist *Dentaria enneaphyllos* (illyrisch-montan), außerdem treten noch *Galium odoratum* und *Hedera helix*, sowie in der Nähe dieser letzteren *Allium ursinum* auf.

Die Assoziation besteht vor allem aus den Hemikryptophyten der montan-subhygrophilen Buchenwälder und mesophilen Buchen-Hainbuchenwälder. Die mitteleuropäischen

Fagetalia-Elemente herrschen vor, aber auch *Cephalanthero-Fagion*- und *Orno-Cotinetalia*-Arten treten häufig auf.

In synökologischer Hinsicht weist die Waldassoziation einen subhygrophilen, eher basiphilen und weniger nitrophilen Charakter auf.

Die eibenreichen Buchenwälder sind intrazonale, sog. »Dauerwaldgesellschaften«, die infolge edaphischer und mesoklimatischer Wirkungen entstanden. Sie sind Übergangassoziationen auf diesem Gebiet zwischen den extrazonalen Buchen-Hainbuchenwäldern, der submediterranartigen Gesellschaft *Laureolae-Fagetum*, und den azonalen, südlich-illyrischen Blumeneschenreichen Buchenwäldern, *Fago-Ornetum*. Das optimale Erscheinen der Eibe an 22 Stellen unseres Gebietes ist mit *Fago-Ornetum* der blumeneschenreichen Dolomitbuchenwälder verbunden. Die Pflanzenassoziationsanalyse beweist den einheimischen Charakter der Eibe in Szentgál.

Der Bakonyer eibenreiche Buchenwald bildet eine Insel des zerbröckelten europäischen Areals und ist in pflanzengeographischer Hinsicht besonders mit den südlichen, vor allem kroatischen Linden-Eibenwäldern (*Tilieto-Taxetum*, Glavač 1958) eng verbunden.

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Acta Botanica Academiae Scientiarum Hungaricae, Tomus 27 (1—2), pp. 105—119 (1981)

IRIS CLASSIFICATION ON THE BASIS OF GENERATIVE CHARACTERISTICS

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(Received January 15, 1980)

Iris pumila L. taxonomically is a controversial taxon, for in the description of its vegetative and generative characteristics no consistent and unequivocal standpoint has been taken. Relying on data obtained in our earlier examinations (MELKÓ 1976) taxonomical studies were carried out based on the sizes of the plant's generative parts. The material of the examinations consisted of living *Iris pumila* L. (*I. taurica* LODD.) individuals collected in 1973—1975 in Hungary, Caucasus and Trans-Caucasus. These were transplanted in the experimental area of the Institute and the series of measurement was taken of 60 flowering plants. The data were processed according to ORLOCI's agglomerative cluster analysis. According the results of our analyses, there is no separation of *I. taurica* LODD. as an independent taxon, of groups by place of origin, of infraspecific taxa.

Introduction

The present study is related to our preceding paper (MELKÓ 1976), in which we drew the conclusion that, on the basis of the measurements of the plant's vegetative parts, and the proportions derived from them, the *Iris pumila* L. taxon living in the Carpathian basin, cannot be classified into homogeneous groups either in a geographical respect or in accordance with the taxonomical classifications used at the present time. For an unequivocal taxonomic determination, this time, we have taken into consideration the generative measures of the plant (Table 1).

It seems that apparently many generative characteristics have been used. However it was hoped that in this way the really insignificant taxonomically generative characteristics could be avoided and the value of the size of some generative parts of the living plants could be ascertained and our own data could be compared with that of the taxonomic literature.

Material and method

The agglomerative cluster analysis of ORLOCI (1967) was used for which a FORTRAN program was worked out by GOLDSTEIN and GRIGAL (1972). The data processing was carried out on the CDC 3300 computer of the Hungarian Academy of Sciences.

60 living plants were used, 41 of which were collected in Hungary, from original sites, 6 of them were of house garden origin which had been planted into the house gardens from their original growth area; 13 individuals were from the Caucasus, Transcaucasus; these were collected personally (Table 2).

All the plants were collected in a lowering state. The plants could not be classified into infraspecific taxa by the taxonomical characteristics serving as a basis for our study and occurring in major floral works (Table 1). For in these works the infraspecific taxa are either

Table 1

Specific and infraspecific characteristics

Author	Ascherson, P.— Graebner, P. (1905—1907)	Hegi, G. (1909)	Bernátsky, J. (1911)	Jávorka, S. (1925)	Flora USSR
Designation of taxon	*Iris pumila* L.	*I. pumila* L.	*I. pumila* L.	*I. pumila* L.	*I. pumila* L.
Plant height (cm)		10—17			10—15
Peduncle* Internode Stem (cm)	no	hardly any	2—4	very short	almost undeveloped
Leaf length (cm)	shorter than 10 cm	10	10—15	4—20	10
Leaf width (mm)		6—20	7—12 (20)		12
Petal tube length (cm)	4—5 times longer than the ovary	5—7	5—8	3—5 times longer than the ovary	4.8
Outer tepal length (cm)	about 5	5	4—6		almost identical length with that of the inner tepal
Outer tepal width (mm)			17—24		thinner than the inner tepal
Hair width (mm)			3—4		
Hair height (mm)			3—4		
Inner tepal length (cm)	longer than the outer tepal	longer than the outer tepal	4—6		
Inner tepal width (mm)			17—24		

taken into consideration by various authors

Flora USSR		Flora of Kaukasus (1940)		Soó, R. (1973)			
— var. *elongata* LIPSKY	— var. *aequiloba* LDB.	*I. pumila* L.	— var. *elongata* LIPSKY	*I. pumila* L.	— var. *pumila*	— var. *scapifera* BORB. in DÖRFL.	— var. ***tristis*** (RCHB. 1847 p. sp.) BAKER 187 3 (*I. Clusiana* RCHB. 1847)
sometimes 12 (cm)		10—15			—1	—5	
		6—8					
			almost 10 times longer than the ovary		3—5 times longer than the ovary		
		5—5.5			4—6		
		a little longer than the outer tepal			4—6		
	rarely is of the same width as the outer tepals						

Author	ASCHERSON, P.— GRAEBNER, P. (1905—1907)	HEGI, G. (1909)	BERNÁTSKY, J. (1911)	JÁVORKA, S. (1925)	Flora USSR
Filament length (mm)	about same length as the anther	same length as the anther	10—14		
Anther length (mm)			shorter than the filament		
Capsule length (cm)		4—6			
Seeds length (mm)		4—7			
Ovary length (mm)			7—13		
Bract length (cm)			5—8		
Peduncle length (mm)			1—3		

* Various authors use alternatively the designations peduncle, scape, stem and internode. A unifying and clear definition of this is given by MÁNDY (1947) (in PRISZTER 1963).

Note. In our study we used individuals originating from the *Iris pumila* L. populatio of Hungary and the Caucasus (Table 2), therefore the Flora Republicii Socialiste Romina (1966), which describes the taxa indigenous in Roumania, is missing from this Table.

absent completely or if they are present the main taxonomical characteristics are not consistent and systematic.

In our work, not only the characteristics which have been described so far are considered but also those about which we supposed that taxonomically they probably have cardinal parameters (Table 3 and Figs 1—3). The fact was especially inspiring for out work that, of the species examined, certain populations could have more or less been classified into individual infraspecific taxa, as within the individual populations the individuals arranged themselves into a completely transitional line.

According to BERNÁTSKY (1911) the taxonomic value of the various taxa, and their constancy, most varying and it still needs a deta'led examination. He relates his statement to the *Iris pumila* L. species and their relatives originating from Hungary, Transsylvania as well as from the Balkans and from Western Europe.

Both the above observations, and BERNÁTSKY's position (1911) were taken into consideration, and without any previous classification the cluster analyses were carried out with all individuals.

After collecting the plants were planted in the experimental area of the Institute, where they were grown for a year, to eliminate the diverse effects the original growth area (soil, climate, etc.). By considering the flower parts of the plant (flower equation: $P_{3+3}A_{3+}$«Gl_3l) and other generative characteristics, 50 measurements were made (Table 3 and Figs 1—3), according to the so-called localized sampling (HORÁNSZKY—SZŐCS 1972). At the sampling time all the plants were in identical phenophases.

The rockbeds of the places of origin.

Pilis — dolomite, limestone of Dachstein
Vértes — dolomite
Csíki Mountains — sandstone, limy conglomerate

Flora USSR		Flora of Kaukasus (1940)		Soó, R. (1973)			
					8—10	10—16	

Esztergom — limestone of Dachstein
Debrecen — sandy loess
Vácrátót — loess, clay
Caucasus, Transcaucasus — probably volcanic rockbed.

The Caucasian, Transcaucasian plants were used because GROSSHEIM (1940) when describing the *Iris pumila* L. species and its three subspecies taxa, claims that *I. pumila* L. possesses a narrow European area in the strict sense of the word. The Caucasian *I. pumila* L. undoubtedly constitutes a separate species or more than one species, but — owing to the lack of enough data decisive answer on this question — he considers his hypothesis as an open question. GAVRILENKO (1955; verbal communication 1974) is of the same opinion and he uses the designation *I. pumila* L. while it is not unambiguously proved that the designation *I. taurica* LODD. is justified. We considered the plants collected in the Caucasus and Transcaucasus conditionally as *I. taurica* LODD.

Results

Three analyses in Dendrograms I—III (see also Figs 4—6) are presented. The first analysis was carried out on the basis of data on 60 plants (Dendrogram I, Fig. 4); in the second analysis we did not take into consideration the plants originating from domestic house gardens (Dendrogram II, Fig. 5); the third analysis (Dendrogram III, Fig. 6) was carried out on the basis of only 33 individuals. Dendrogram I (Fig. 4).

The dendrogram is divided into two great clusters (A and B).

Cluster A consists of part of the individuals collected from domestic growth areas and from the Caucasus. The Caucasian individuals are from Tbilisi and areas near Tbilisi.

Table 2

Designation of sites of origin

Serial number	Designation of taxa	Name of collecting site
1.	*Iris pumila* L.	Pilisszentkereszt
2.	*Iris pumila* L.	Pilisszentkereszt
3.	*Iris pumila* L.	Pilisszentkereszt
4.	*Iris pumila* L.	Pilisszentkereszt
5.	*Iris pumila* L.	Pilisszentkereszt
6.	*Iris pumila* L.	Piliscsaba
7.	*Iris pumila* L.	Piliscsaba
8.	*Iris pumila* L.	Piliscsaba
9.	*Iris pumila* L.	Piliscsaba
10.	*Iris pumila* L.	Piliscsaba
11.	*Iris pumila* L.	Pusztavám
12.	*Iris pumila* L.	Pusztavám
13.	*Iris pumila* L.	Pusztavám
14.	*Iris pumila* L.	Pusztavám
15.	*Iris pumila* L.	Budaörs, Csiki Mounts
16.	*Iris pumila* L.	Budaörs, Csiki Mounts
17.	*Iris pumila* L.	Szentendre
18.	*Iris pumila* L.	Szentendre
19.	*Iris pumila* L.	Szentendre
20.	*Iris pumila* L.	Budaörs, Csiki Mounts
21.	*Iris pumila* L.	Esztergom, Donkey Mount
22.	*Iris pumila* L.	Esztergom, Donkey Mount
23.	*Iris pumila* L.	Esztergom, Donkey Mount
24.	*Iris pumila* L.	Esztergom, Donkey Mount
25.	*Iris pumila* L.	Debrecen
26.	*Iris pumila* L.	Debrecen
27.	*Iris pumila* L.	Debrecen
28.	*Iris pumila* L.	Debrecen
29.	*Iris pumila* L.	Debrecen
30.	*Iris pumila* L.	Debrecen
31.	*Iris pumila* L.	Debrecen
32.	*Iris pumila* L.	Debrecen
33.	*Iris pumila* L.	Debrecen
34.	*Iris pumila* L.	Debrecen
35.	*Iris pumila* L.	Pilis (top)
36.	*Iris pumila* L.	Pilis (top)
37.	*Iris pumila* L.	Pilis (top)

Serial number	Designation of taxa	Name of collecting site
38.	*Iris pumila* L.	Pilis (top)
39.	*Iris pumila* L.	Pilis (top)
40.	*Iris pumila* L.	Pilis (top)
41.	*Iris pumila* L.	Pilis (top)
42.	*Iris pumila* L.	Vácrátót, house-garden
43.	*Iris pumila* L.	Vácrátót, house-garden
44.	*Iris pumila* L.	Vácrátót, house-garden
45.	*Iris pumila* L.	Vácrátót, house-garden
46.	*Iris pumila* L.	Vácrátót, house-garden
47.	*Iris pumila* L.	Vácrátót, house-garden
48.*	*Iris pumila* L.	Azerbaidzhan: Eilyar-Ougi Mount
49.*	*Iris pumila* L.	Azerbaidzhan: Eilyar-Ougi Mount
50.*	*Iris pumila* L.	Mcheta
51.*	*Iris pumila* L.	Near Tbilisi in the Caucasus
52.*	*Iris pumila* L.	Mcheta
53.*	*Iris pumila* L.	Mcheta
54.*	*Iris pumila* L.	Mcheta
55.*	*Iris pumila* L.	Azerbaidzhan: Sirakskiy steppe
56.*	*Iris pumila* L.	Near Tbilisi in the Caucasus
57.*	*Iris pumila* L.	Azerbaidzhan: Sirakskiy steppe
58.*	*Iris pumila* L.	Azerbaidzhan: Sirakskiy steppe
59.*	*Iris pumila* L.	Georgia: Garebzsiyskiy steppe
60.*	*Iris pumila* L.	Georgia: Garebzsiyskiy steppe

* At the time of collecting these individuals we considered them conditionally as *Iris taurica* LODD. taxa.

Cluster B consists of two smaller clusters.

Cluster Ba contains individuals originating from domestic house gardens. It is only these individuals that organize themselves into smaller clusters at a relatively low level (20%, 40%).

Cluster Bb contains individuals from Georgia and Azerbaidzhan. Three plants are relatively closely linked to one another, these originate from Azerbaidzhan. The two plants from Georgia are already relatively less similar to each other, and the similiraty is even smaller between the two individuals collected from the Eiljar-Ougi mountains in Azerbaidzhan. These plants organize themselves into a cluster at the 60% level. The plants from Azerbaidzhan were collected from the *Iris* stand living in the Botany Garden of the Georgian Academy of Sciences, Tbilisi.
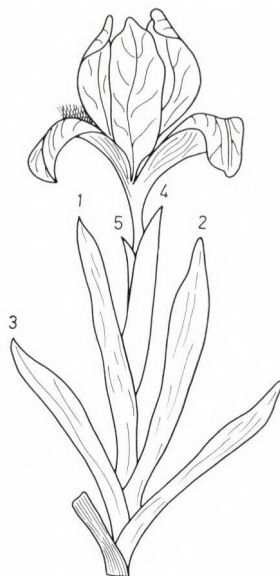
Fig. 1. Points of measurement on the *Iris pumila* L. species. — 1. First leaf; 2. Second leaf; 3. Third leaf; 4. Outer bract; 5. Inner bract
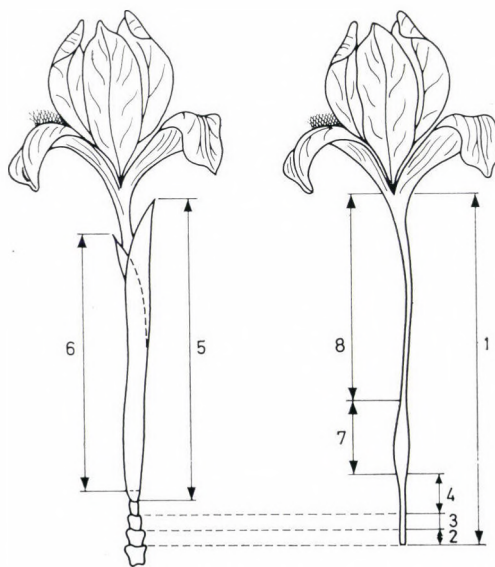
Fig. 2. Points of measurement on the *Iris pumila* L. species. — The designation of characteristics measured, and marked by Arabic numbers, is contained in Table 3

Table 3

Designation of characteristics measured

1.	Length extending from the node of third leaf to the furcate branching of tepals
2.	Distance between third and second leaves
3.	Distance between second and first leaf
4.	Distance between first leaf and ovary
5.	Length of outer bract
6.	Length of inner bract
7.	Length of ovary
8.	Length of petal tube
9.	Length of outer tepal
10.	Maximum width of outer tepal
11.	Length of hair on outer tepal
12.	Width of hair on outer tepal
13.	Height of hair on outer tepal
14.	Length of outer tepal
15.	Maximum width of outer tepal
16.	Length of hair outer tepal
17.	Width of hair on outer tepal
18.	Height of hair on outer tepal
19.	Length of outer tepal
20.	Maximum width of outer tepal
21.	Length of hair on outer tepal
22.	Width of hair on outer tepal
23.	Height of hair on outer tepal
24.	Length of inner tepal
25.	Maximum width of inner tepal
26.	Length of tepal stipe on inner tepal
27.	Length of inner tepal
28.	Maximum width of inner tepal
29.	Length of metal stipe on inner tepal
30.	Length of inner tepal
31.	Maximum width of inner tepal
32.	Tepal stipe length on inner tepal
33.	Length of petaloform pistil
34.	Maximum width of limb of pistil
35.	Length of limb of pistil
36.	Length of lobe of pistil
37.	Length of petaloform pistil
38.	Maximum width of petaloform pistil
39.	Length of limb of pistil
40.	Length of lobe of pistil
41.	Length of petaloform pistil
42.	Maximum width of petaloform pistil
43.	Length of limb of pistil
44.	Length of lobe of pistil
45.	Length of anther
46.	Length of filament
47.	Anther length
48.	Filament length
49.	Anther length
50.	Filament length

(Figs 1—3 demonstrate the characteristics measured.)
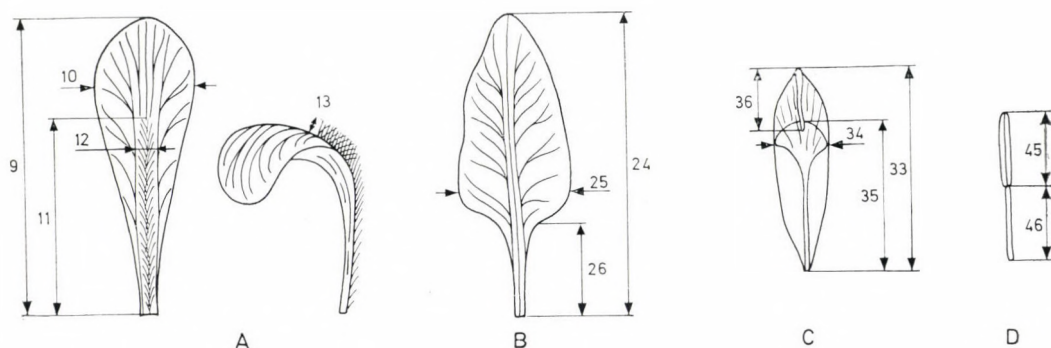
Fig. 3. Points of measurement on the flower organs of *Iris pumila* L. — A = Outher tepal (Nos 9, 14, 19; 10, 15, 20; 11, 16, 21; 12, 17, 22; 13, 18, 23; indicate identical sites of measurement) — B = Inner tepal (Nos 24, 27, 30; 25, 28, 31; 26, 29, 32; indicate identical sites of measurement) — C = Pistil (Nos 33, 37, 41; 34, 38, 42; 35, 39, 43; 36, 40, 44; indicate identical sites of measurement) — D = Stamen (Nos 45, 47, 49; 46, 48, 50, indicate identical sites of measurement). — The designation of characteristics measured, and marked by Arabic numbers, is given in Table 3

It can be stated from Dendrogram I that *I. pumila* L. does not give a group according to the habitat. The Caucasian and Transcaucasian individuals of "*I. taurica* LODD." character are not separate from the domestic *I. pumila* L. individuals. Although part of the Caucasian individuals forms a smaller cluster, but the group of individuals originating from house gardens of Hungary resemble this cluster more the other, Caucasian individuals. The latter do not form a cluster, the individual No. 50 organized itself into a cluster containing individuals from Hungary. Individuals Nos 14, 17, 21, 23, 22, 33, and 34 organized themselves into a cluster at a relatively low percentage level. These individuals originate from Pusztavám, Szentendre, Esztergom, Debrecen. The other clusters containing individuals from Hungary are of similar composition according to areas of origin.

Dendrogram II (Fig. 5)

The data on individuals from house gardens were not considered in the analysis. Dendrogram II also consists of two greater clusters (A and B). Dendrogram II in comparison with Dendrogram I is reorganized. In cluster A there are now only *I. pumila* L. individuals of Hungarian origin, and it separates from Cluster B which consists of domestic and Caucasian individuals. Cluster A is identical with Cluster Aa of Dendrogram I; Cluster Ba corresponds with Cluster Ab of Dendrogram I, and Cluster Ba is now linked to the other Caucasian individuals. In our analysis, the claim that *I. taurica* LODD. is a separate taxon, and of the existence of groups by areas of origin has been excluded.
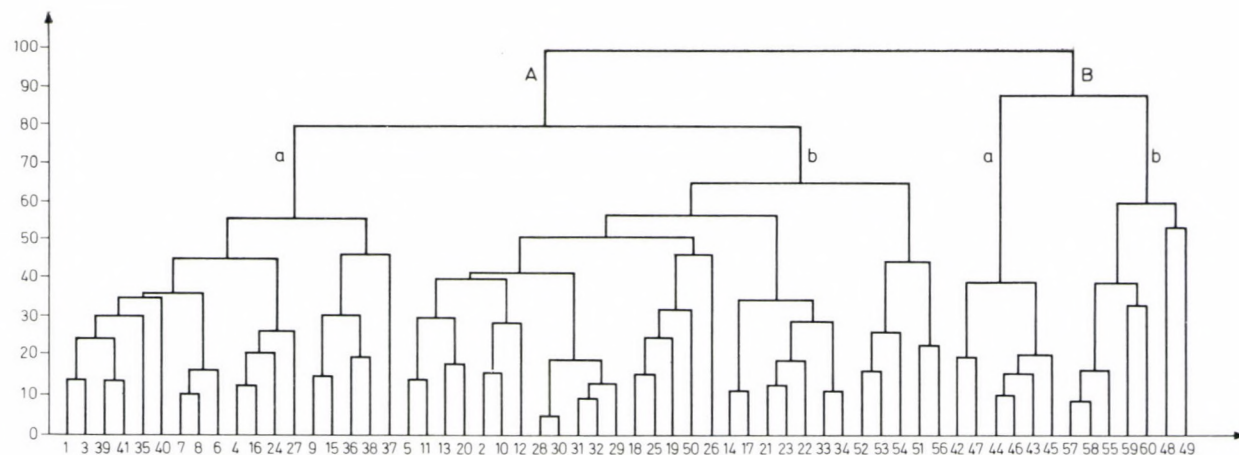
Fig. 4. Dendrogram I. — Analysis of the characteristics measured on 60 plants. (Arabic numbers indicate the site of collecting; Table 2)
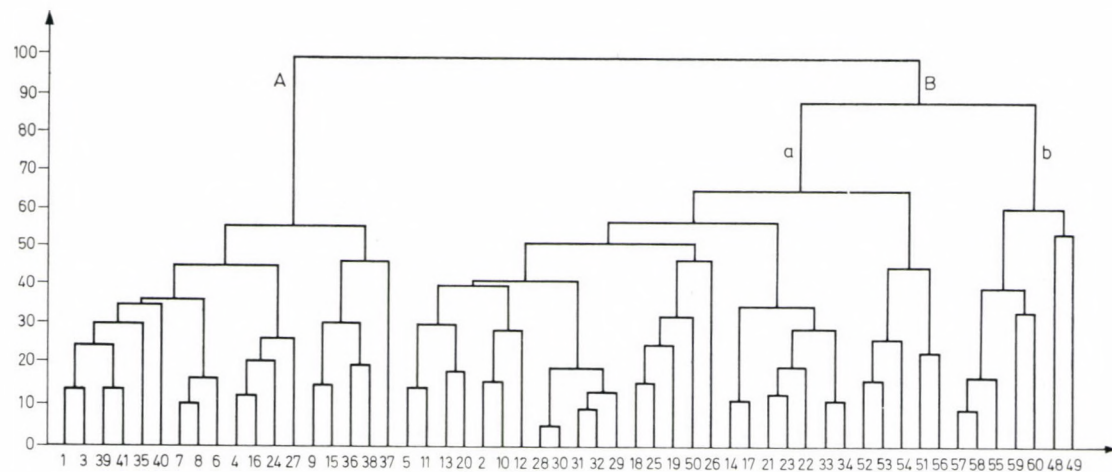
Fig. 5. Dendrogram II. — Analysis of measured characteristics not including the *Iris pumila* L. individuals of domestic house garden origin. (Arabic numbers indicate the origin of sites collecting; Table 2)
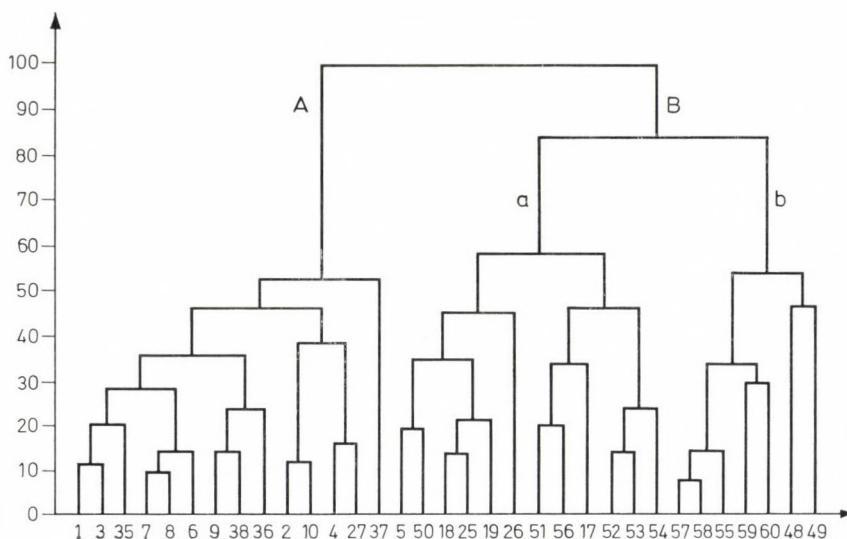
Fig. 6. Dendrogram III. — Analysis of the measured characteristics of 33 plants. (Arabic numbers indicate collecting sites; Table 2)

Dendrogram III (Fig. 6)

In this analysis, the characteristics of only 33 plants were taking into consideration. The individuals collected from Pusztavám, Budaörs: Csíki Mountains, Esztergom: Donkey Mountain, partly from Debrecen, partly from Pilis-top as well as those left out already in the second analysis, that is, cultivated individuals (Table 2) were not considered.

In this analysis, we wanted to know

— what kind of dendrogram can be obtained on the individuals collected from geographically distant areas when the number of specimens originating from populations in Hungary is reduced;

— what values are obtained in the case of geographical isolation, and of Balkan and Ukrainian species missing in our study;

— how the morphological differences in certain populations, and the morphological variability of populations living in identical areas, can be interpreted.

Our analysis provided surprising results.

The dendrogram shows two larger clusters (A and B) also now, but of the three smaller dendrograms (Figs 4, 5 and 6) only Cluster Bb remained systematically constant. Clusters A and Ba in Fig. 6 in comparison with Clusters A and Ba in Fig. 5 have become completely reorganized so that some individuals of the two clusters mixed with one another (e.g. individuals Nos 2 and 10), or other individuals linked with one another (e.g. Nos 5 and 50, 51, 56 and 17), at another similarity level if compared with the preceding dendrogram.

It is surprising that in this analysis individual No. 17, originating from Szentendre, was inserted into the cluster containing Georgian *I. pumila* L. individuals (Nos 51, 56, 52, 53, 54). Therefore, of the Caucasian *I. pumila* L. population it is only the individuals Nos 57, 58, 55, 59, 60, 48, 49 which constitute in all cases a separate small cluster, the others do not. On reducing the number of individuals originating from house gardens of Hungary, the cluster became ever more transformed.

Cluster III does not show the presupposed morphological differences the importance of geographical isolation is not indicated, by the cluster that is, the geographical distance is not a differentiating factor in the formation or separation of the various clusters. The domestic individuals organize themselves into clusters in varying ways.

The possible infraspecific taxa do not separate even at the population level. For example, the individuals originating from Szentendre (Nos 17, 18, 19)

Table 4

CV% of the measured characteristics by size

CV%	Designation of characteristics measured
7.10	Limb of pistil length
8.46	Petaloform pistil length
9.25	Outer tepal length
9.58	Inner tepal length
9.71	Hair length on outer tepal
12.20	Maximum width of petaloform pistil
12.36	Anther length
12.98	Tepal stipe length on inner tepal
14.81	Filament length
15.53	Maximum width of inner tepal
16.46	Length of lobe of pistil
16.69	Ovary length
18.83	Maximum width of outer tepal
20.55	Petal tube length
20.84	Hair height on outer tepal
21.84	Length from the node of third leaf to the furcate branching of tepals
22.86	Outer tepal length
23.31	Inner tepal length
26.34	Hair width on outer tepal
50.42	Distance between third and second leaf
94.87	Distance between first leaves and ovary
111.14	Distance between second and first leaves

do not arrange themselves into one cluster. It is on a relatively low level that the Caucasian individual No. 50 links with individuals Nos 18 and 19; the individual No. 17 links with individuals originating from other domestic areas (Pusztavám, Esztergom, Debrecen, Figs 4 and 5). This individual, No. 17. in Fig. 17, on the other hand organizes a smaller cluster with Caucasian *I. pumila* L. species. Of the individuals from Esztergom (Fig. 4), it is only individuals Nos 21, 22, and 23 that group themselves into Cluster Ab, while individual No. 24 groups in Cluster Aa with individuals from Pilisszentkereszt, Budaörs and Debrecen.

At the initial phase of our work by use of cited floral works (Table 1) we could not distinctly classify the species examined into infraspecific taxa; by the end of our work, this became finally impossible.

All three dendrograms are consistent from one point of view: none of them has such clusters that separate morphologically and by derivation and such that can be properly interpreted at present.

For the evaluation of the characteristics, CV% calculations were carried out (Table 4). In the present paper, 22 CV% data are given; in the flower parts appearing in a 3 repetitions (inner and outher tepal, pistil and stamen), the median CV% values are given; in the three CV% values there are only one—two percent-differences occasionally. The CV% values obtained reflect the reliability of the characteristics measured.

Conclusions

From our work it can be inferred that, on the basis of the 50 generative characteristics measured on the 60 plants by applying the Orloci-type agglomerative cluster analysis, *Iris pumila* L. is a homogeneous species:

— *I. pumila* L. does not present clusters by areas of origin;
— the separation of *I. taurica* Lodd. could not be proved;
— the existence of infraspecific taxa has not been indicated by this analysis.

ACKNOWLEDGEMENTS

I express my thanks to Dr. A. Horánszky and B. D. Gavrilenko for their kind help and advice in collecting the plants; to Dr. A. Borhidi, Dr. G. Fekete and Dr. I. Précsényi, for the discussion of problems that arose during my work, and for their readiness to help.

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Acta Botanica Academiae Scientiarum Hungaricae, Tomus 27 (1–2), pp. 121–140 (1981)

ACCUMULATION OF ELEMENTS IN *CORNUS SANGUINEA* AND *LIGUSTRUM VULGARE* LIVING IN THE EDGE AND INTERIOR OF A FOREST *(QUERCETUM PETRAEAE-CERRIS)**

I. DISTRIBUTION OF ELEMENTS WITHIN SHRUBS

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(Received April 29, 1980)

Investigations have been carried out in the framework of MAB in Hungary in the model area and its surroundings (Síkfőkút Project, JAKUCS 1973, 1978) on five individuals each of *Cornus sanguinea* and *Ligustrum vulgare* shrubs, with respect to the changes in the concentration of certain elements (N, P, K, Ca, Mg, Fe, Mn, Zn, Cu, Na) by plant fractions (leaf, one-year old branch, stem, primary root, secondary root). Furthermore the utilization of elements within the plant and the plant fractions which can be taken up through the root systems in contact with the soil was also studied.

Samples from 3 areas were analysed: from the sessile-turkey-oak forest of closed canopy from the northern edge of the forest adjacent to agricultural areas, and from shrubhedges surrounded by treeless agricultural areas.

It was established that always the physiologically most active parts of the plants, that is, the leaves and the root-hairs contain the elements in the highest concentration of macroelements (N, P, K, Ca and Mg) occurs in the leaf, while the microelements (Fe, Mn, Zn and Cu) accumulate large amount primarily in the root-hairs. The stem and the primary root do not differ significantly with respect to most elements. Likewise the one-year old branches and the primary roots have nearly the same role in the accumulation of elements. Of the two shrub species, *Ligustrum vulgare* contains all the elements — with the exception of Ca and Mg — in higher concentrations than *Cornus sanguinea*. In the leaf, one-year-old branch and primary root fraction of shrubs, the concentration-factor of all the elements is high. A high degree of in-plant accumulation is characteristic of N, Fe and K (10^0—10^3). In spite of the high Ca-concentration in the soil, the Ca-utilization of shrubs is unsatisfactory, the concentration of Ca is of 10^{-1}—10^0.

Introduction

Nutrient uptake and element accumulation as well as a knowledge of soil-plant relationship are important part features of the "Síkfőkút Project" complex ecological investigations in Hungary. The total element contents and changes in element concentrations of the annual phytoproduction of trees, shrubs and herbs of the oak forest have already been analysed in several papers (MÉSZÁROS 1977, 1979; ANTAL 1978, JACSÓ 1978, PAPP, B. 1982, MÉSZÁROS 1982).

In this paper the experimental results are presented which were through a detailed analysis of two selected dominant shrub species *Cornus sanguinea* and *Ligustrum vulgare*. Our examinations had a double twofold purpose, namely to ascertain in detail the distribu-

* "Síkfőkút Project" No. 65.

Table 1

Means and standard error of means of pH, organic matter

		pH		Organic matter %	Total-N %	NH_4-N+NO_3-N
		KCl	dest. w.			
Ligustrum vulgare						
Oak forest	$\bar{x}$	5.00	5.72	7.29	0.34	40.48
	s	0.3448	0.3977	0.5400	0.0228	3.7860
Forest edge	$\bar{x}$	6.04	6.69	6.45	0.36	51.95
	s	0.3764	0.4210	1.2877	0.0743	15.5914
Shrub hedge	$\bar{x}$	6.69	7.05	4.17	0.28	23.40
	s	0.0573	0.1373	1.2084	0.0374	3.7440
Cornus sanguinea						
Oak forest	$\bar{x}$	5.17	5.93	6.25	0.28	41.64
	s	1.0730	0.8940	2.0549	0.1075	9.7965
Forest edge	$\bar{x}$	6.09	6.71	7.66	0.35	58.04
	s	0.2181	0.1541	1.0843	0.0526	11.1684
Shrub hedge	$\bar{x}$	6.88	7.14	3.57	0.23	22.16
	s	0.0939	0.1293	1.7961	0.0771	7.9224

tion of elements in the plant and the utilization of the available element supply within the shrub from the soil; furthermore we were looking for differences in the element concentration in individuals of the same two shrub species whether living in forests, forest edges and by the side of uninterrupted forest cover, in shrub hedges that have survived among agricultural areas. It is stressed by several authors that a forest edge forming between a forest and the treeless area adjacent to it, being also structurally different from the forest, is of vital importance for the long-term survival and functional stability of the forest, because it bars and wards off the unfavourable effects reaching the forest from outside (JAKUCS 1968, 1972; WALES 1972; RANNEY 1977, etc.).

In Part I of the study the element concentrations in the various fractions of the shrubs, and the utilization of the available element supply of the soil within the shrub will be presented. The assessment of the results from the viewpoint of the woodland margin will be given in Part II of the study.

The research area and the sampling sites

The examinations were carried out in the research area and its surroundings called Síkfőkút Project, lying in the hill region of the North Hungarian Central mountain ranges (JAKUCS 1973, 1978). One of the sampling sites was the interior of the sessile-turkeyoak forest with an enclosed canopy, which is a homogeneous 75 years-old stand of sprout origin; there has been no forestry activity in it for about 25 years. Several studies give descriptions of the forest and the structural indices of the shrub species occurring in the forest (JAKUCS, HORVÁTH, KÁRÁSZ 1975; KÁRÁSZ 1976; KÁRÁSZ 1982).

and element concentrations in the soil of root zone

K	Ca	Mg	Fe	Mn	Cu	Zn	Na
mg. kg^{-1}							
153.76	2851.30	517.26	10.61	1407.30	0.74	14.56	8.24
14.9328	495.0221	46.1537	4.3500	122.7537	0.1274	1.3680	0.1807
303.22	4355.04	440.76	9.21	1356.50	0.81	16.86	8.94
72.9811	312.8056	40.7770	1.6228	114.060	0.1701	4.8222	2.3351
115.52	4478.80	317.52	0.60	76.63	0.35	1.50	10.43
62.5512	1016.1694	201.6343	0.8603	62.5833	0.2134	2.7103	5.5592
147.96	3024.86	531.28	12.04	1205.70	0.84	10.12	8.21
16.4649	1545.4207	120.5162	8.1584	306.1389	0.3367	4.4909	2.2328
253.24	4287.54	469.78	8.47	1290.30	0.97	12.28	9.29
32.2047	500.4027	42.9151	1.5967	174.5185	0.3516	3.3423	1.2561
75.60	4917.52	205.44	0.30	34.08	0.24	0.26	8.03
26.4971	88.0903	83.1473	0.1476	29.8900	0.0731	0.0217	1.0304

In the northern edge of the turkey-oak-forest which is connected with a vineyardarea, a closed forest margin has developed. This was our second sampling site. The shrub hedge, lying 500 m from the margin of the turkey oak-forest and surrounded by agricultural areas to the north, strongly exploited by man, was the third sampling site.

The soil in the sampling sites is brown forest soil with clay illuviation (KOVÁCS 1978).

Sampling methods

The five cases of *Cornus sanguinea* and *Ligustrum vulgare* predominant in all three sampling sites, were chosen randomly, on September 29, 1977. Three kinds of samples were taken from the shoot system of all the selected shrubs: — leaf samples consisting of 150 leaves; — one-year-old branch sample containing 20 branches of 15—20 cm length and less than 2 mm in diameter; — stem sample, containing 5 pieces of 10 cm length each.

After digging individuals two kinds of root samples were taken: primary root samples, containing 5 primary root pieces of 10 cm length each, and so-called root-hair samples containing root branches of less than 1 mm dia. The fractions taken in this way were treated separately. Also, the soil samples were collected from under the shrubs in direct contact with the roots were collected.

Chemical analysis of the samples

We used KJELDAHL's method to determine the N-content in plant samples while for P the molybdate blue method; and the concentration of K, Ca, Mg, Fe, Mn, Zn, Cu and Na was determined on a UNICAM SP 1900 type atomic-absorption spectrophotometer.

Table 2

Means and standard error of means of macro- and microelement concentrations and comparison of mean values in the fractions of Ligustrum vulgare of oak forest (n = 5)

Fraction		$\bar{x}$	s	One-year-old branch	Stem	Primary root	Root-hair
				SD5%			
Leaf	N %	2.389	0.1896	0.256***	0.215***	0.239***	0.250***
	P %	0.301	0.0325	0.037***	0.039***	0.042***	0.044***
	K %	2.173	0.2489	0.291***	0.311***	0.317***	0.321***
	Ca %	0.863	0.0644	0.074***	0.083***	0.083***	0.122***
	Mg %	0.295	0.0504	0.064**	0.064***	0.064***	0.067**
	Fe mg kg^{-1}	309.00	69.7522	86.52**	89.22**	89.46+	258.21***
	Mn mg kg^{-1}	300.06	49.4471	62.58***	62.48***	55.63***	NS
	Cu mg kg^{-1}	6.00	1.3177	NS	1.67*	NS	3.37***
	Zn mg kg^{-1}	56.12	21.1588	NS	26.81*	26.66*	NS
	Na mg kg^{-1}	104.65	18.8607	31.30***	29.44***	26.50*	121.73***
	ash %	10.12	0.3030	0.45***	0.34***	0.62***	0.71***
One-year-old branch	N %	1.260	0.0765	—	0.118***	0.100***	0.104*
	P %	0.183	0.0132	—	0.017***	0.016***	0.018***
	K %	1.259	0.1312	—	0.164***	0.148***	0.236*
	Ca %	0.202	0.0318	—	0.039**	0.039**	NS
	Mg %	0.110	0.0083	—	0.012***	0.014***	0.018***
	Fe mg kg^{-1}	164.25	46.3517	—	61.33**	62.46*	249.95***
	Mn mg kg^{-1}	66.29	9.4029	—	13.42***	24.09*	58.01***
	Cu mg kg^{-1}	7.40	2.0627	—	2.59*	NS	3.75***
	Zn mg kg^{-1}	47.51	7.8564	—	9.17***	8.87***	NS
	Na mg kg^{-1}	53.70	23.7120	—	NS	NS	123.03***
	ash %	4.12	0.3152	—	0.36***	0.63***	0.72***
Stem	N %	0.557	0.0844	—	—	0.108*	0.109***
	P %	0.043	0.0047	—	—	0.009***	0.017***
	K %	0.284	0.0178	—	—	0.075**	0.234**
	Ca %	0.119	0.0195	—	—	NS	0.125*
	Mg %	0.044	0.0070	—	—	0.012**	0.022***
	Fe mg kg^{-1}	58.45	16.8844	—	—	43.73***	244.12***
	Mn mg kg^{-1}	34.85	8.9689	—	—	23.91***	57.90***
	Cu mg kg^{-1}	4.03	0.2699	—	—	2.01*	3.72***
	Zn mg kg^{-1}	25.46	4.1390	—	—	NS	8.80**
	Na mg kg^{-1}	38.23	21.3638	—	—	28.46*	122.37***
	ash %	1.24	0.1390	—	—	0.67**	0.79***

Primary root	N %	0.701	0.0250	—	—	—	0.086***
	P %	0.069	0.0088	—	—	—	0.019***
	K %	0.447	0.0571	—	—	—	0.242**
	Ca %	0.134	0.0214	—	—	—	NS
	Mg %	0.068	0.0094	—	—	—	0.018***
	Fe mg kg^{-1}	227.25	38.8153	—	—	—	247.96***
	Mn mg kg^{-1}	99.82	21.3357	—	—	—	52.10***
	Cu mg kg^{-1}	6.93	1.5942	—	—	—	3.49***
	Zn mg kg^{-1}	22.41	3.4719	—	—	—	8.49**
	Na mg kg^{-1}	75.32	17.3861	—	—	—	121.39***
	ash %	2.51	0.5187	—	—	—	0.83***
Root-hair	N %	1.128	0.0641	—	—	—	—
	P %	0.119	0.0119	—	—	—	—
	K %	0.947	0.1861	—	—	—	—
	Ca %	0.245	0.0987	—	—	—	—
	Mg %	0.163	0.0160	—	—	—	—
	Fe mg kg^{-1}	1143.46	195.6275	—	—	—	—
	Mn mg kg^{-1}	332.70	45.6988	—	—	—	—
	Cu mg kg^{-1}	20.12	2.9803	—	—	—	—
	Zn mg kg^{-1}	40.33	7.4436	—	—	—	—
	Na mg kg^{-1}	621.69	96.0781	—	—	—	—
	ash %	5.86	0.6190	—	—	—	—

Table 3

Means and standard error of means of macro- and microelement concentrations and comparison of mean values in the fractions of Ligustrum vulgare of a turkey oak-forest edge (n = 5)

Fraction		$\bar{x}$	s	One-year-old branch	Stem	Primary root	Root-hair
				SD5%			
Leaf	N %	1.892	0.2933	0.360***	0.375***	0.370***	0.353***
	P %	0.251	0.0857	0.099*	0.108**	0.111*	0.111+
	K %	1.464	0.6020	NS	0.751**	0.751*	NS
	Ca %	0.981	0.1842	0.231***	0.231***	0.231***	0.208***
	Mg %	0.273	0.0429	0.053***	0.053***	0.058***	0.056*
	Fe mg kg^{-1}	250.48	76.3752	95.35*	89.69**	107.57*	710.73**
	Mn mg kg^{-1}	259.75	84.5405	107.69**	105.45**	105.95**	109.05+
	Cu mg kg^{-1}	5.66	2.2729	3.60**	NS	NS	5.92***
	Zn mg kg^{-1}	39.65	20.0810	NS	25.88+	NS	NS
	Na mg kg^{-1}	100.62	25.9192	NS	30.19**	33.81**	136.27***
	ash %	9.21	0.3422	0.56***	0.44***	0.41***	1.88*
One-year-old branch	N %	1.103	0.1873	—	0.247**	0.242**	NS
	P %	0.136	0.0439	—	0.056*	0.051*	NS
	K %	1.081	0.2165	—	0.275***	0.278**	NS
	Ca %	0.160	0.0138	—	0.030**	0.028**	NS
	Mg %	0.106	0.0061	—	0.007***	0.025*	0.022***
	Fe mg kg^{-1}	140.32	51.8284	—	NS	NS	707.30**
	Mn mg kg^{-1}	56.04	18.8457	—	24.94*	NS	31.03***
	Cu mg kg^{-1}	12.17	2.6432	—	3.32**	3.42**	6.08***
	Zn mg kg^{-1}	47.94	11.7981	—	13.44**	14.85**	NS
	Na mg kg^{-1}	91.61	36.5988	—	48.50*	43.08*	116.33***
	ash %	3.50	0.4173	—	0.53***	0.48***	1.90**
Stem	N %	0.430	0.0702	—	—	0.092**	0.196***
	P %	0.069	0.0117	—	—	NS	0.028***
	K %	0.219	0.0464	—	—	0.074**	0.375**
	Ca %	0.105	0.0269	—	—	NS	0.108*
	Mg %	0.038	0.0028	—	—	0.022*	0.019***
	Fe mg kg^{-1}	118.12	41.2841	—	—	NS	706.23**
	Mn mg kg^{-1}	21.65	6.8825	—	—	13.15***	30.32***
	Cu mg kg^{-1}	4.27	0.3996	—	—	NS	6.56***
	Zn mg kg^{-1}	19.56	5.4818	—	—	NS	8.15***
	Na mg kg^{-1}	36.61	13.5000	—	—	NS	133.46***
	ash %	1.16	0.0864	—	—	0.22***	1.83***

Primary root	N %	0.630	0.0555	—	—	—	0.231**
	P %	0.085	0.0213	—	—	—	0.032**
	K %	0.354	0.0555	—	—	—	0.378**
	Ca %	0.119	0.0237	—	—	—	0.108*
	Mg %	0.066	0.0181	—	—	—	0.025***
	Fe mg kg^{-1}	123.57	70.7827	—	—	—	709.84**
	Mn mg kg^{-1}	52.25	10.7180	—	—	—	26.58***
	Cu mg kg^{-1}	5.88	1.9944	—	—	—	6.99***
	Zn mg kg^{-1}	22.22	1.8715	—	—	—	7.42***
	Na mg kg^{-1}	39.61	19.9814	—	—	—	134.71***
	ash %	1.87	0.1935	—	—	—	1.85**
Root-hair	N %	1.099	0.1765	—	—	—	—
	P %	0.147	0.0230	—	—	—	—
	K %	1.096	0.2980	—	—	—	—
	Ca %	0.231	0.0831	—	—	—	—
	Mg %	0.182	0.0159	—	—	—	—
	Fe mg kg^{-1}	1434.15	566.5459	—	—	—	—
	Mn mg kg^{-1}	175.52	23.3937	—	—	—	—
	Cu mg kg^{-1}	31.49	5.2599	—	—	—	—
	Zn mg kg^{-1}	51.18	5.6680	—	—	—	—
	Na mg kg^{-1}	613.23	106.4959	—	—	—	—
	ash %	6.94	1.4710	—	—	—	—

Table 4

Means and standard error of means of macro- and microelement concentrations and comparison of mean values in the fractions of Ligustrum vulgare of shrub-hedge (n = 5)

Fraction		$\bar{x}$	s	One-year-old branch	Stem	Primary root	Root-hair
				$SD_{5\%}$			
Leaf	N %	1.881	0.4670	0.606*	0.587**	0.587**	0.587*
	P %	0.322	0.0970	0.122*	0.122**	0.122**	0.122*
	K %	1.058	0.0769	NS	0.095***	0.102***	NS
	Ca %	1.278	0.1303	0.164***	0.164***	0.164***	0.178***
	Mg %	0.271	0.0617	0.078**	0.078**	0.078**	0.083*
	Fe mg kg^{-1}	222.54	43.2194	60.31**	58.12***	57.11*	573.01**
	Mn mg kg^{-1}	244.17	41.5278	53.65***	51.77***	53.05***	65.09***
	Cu mg kg^{-1}	8.14	2.0786	5.37*	3.24*	NS	24.00**
	Zn mg kg^{-1}	75.34	14.3944	20.03**	18.24**	18.35**	20.62**
	Na mg kg^{-1}	56.93	8.5062	40.39**	18.95**	NS	420.27*
	ash %	10.87	1.1114	1.62***	1.39***	1.41***	1.70**
One-year-old branch	N %	1.075	0.1405	—	0.162***	0.162***	NS
	P %	0.135	0.0150	—	0.018***	0.018***	0.018+
	K %	1.071	0.1480	—	0.195***	0.200***	NS
	Ca %	0.179	0.0114	—	NS	0.028+	0.078*
	Mg %	0.100	0.0139	—	0.017***	0.017**	0.028***
	Fe mg kg^{-1}	132.74	22.0282	—	29.26**	NS	571.14***
	Mn mg kg^{-1}	43.32	11.7340	—	15.08**	15.80*	42.23*
	Cu mg kg^{-1}	13.14	3.7881	—	5.10**	4.48**	24.33*
	Zn mg kg^{-1}	44.69	7.2301	—	9.66**	8.19***	NS
	Na mg kg^{-1}	135.73	31.3521	—	34.93***	35.73***	421.94+
	ash %	3.88	0.6878	—	0.87**	0.90**	1.74***
Stem	N %	0.508	0.0697	—	—	NS	0.099***
	P %	0.075	0.0092	—	—	0.014+	0.014***
	K %	0.282	0.0492	—	—	0.081*	0.166***
	Ca %	0.147	0.0236	—	—	NS	0.081*
	Mg %	0.030	0.0041	—	—	0.006***	0.031***
	Fe mg kg^{-1}	86.27	17.8083	—	—	24.43**	570.81***
	Mn mg kg^{-1}	17.22	3.0881	—	—	NS	41.46**
	Cu mg kg^{-1}	4.58	1.5728	—	—	NS	24.01**
	Zn mg kg^{-1}	22.01	2.8449	—	—	NS	11.01**
	Na mg kg^{-1}	29.14	12.6495	—	—	19.97+	420.53*
	ash %	1.36	0.1195	—	—	0.27**	1.54***

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Primary root	N %	0.557	0.0697	—	—	—	0.099***
	P %	0.087	0.0105	—	—	—	0.014***
	K %	0.364	0.0626	—	—	—	0.166***
	Ca %	0.152	0.0236	—	—	—	0.081*
	Mg %	0.052	0.0032	—	—	—	0.031***
	Fe mg kg^{-1}	123.77	15.5635	—	—	—	570.81***
	Mn mg kg^{-1}	22.67	9.8024	—	—	—	41.96**
	Cu mg kg^{-1}	5.85	2.1058	—	—	—	24.01**
	Zn mg kg^{-1}	19.76	3.2580	—	—	—	11.01**
	Na mg kg^{-1}	48.77	14.6140	—	—	—	420.53*
	ash %	1.78	0.2371	—	—	—	1.54***
Root-hair	N %	0.996	0.0653	—	—	—	—
	P %	0.151	0.0086	—	—	—	—
	K %	1.105	0.1491	—	—	—	—
	Ca %	0.267	0.0606	—	—	—	—
	Mg %	0.164	0.0237	—	—	—	—
	Fe mg kg^{-1}	1939.53	458.8612	—	—	—	—
	Mn mg kg^{-1}	95.53	31.8787	—	—	—	—
	Cu mg kg^{-1}	53.09	19.1944	—	—	—	—
	Zn mg kg^{-1}	41.95	8.2364	—	—	—	—
	Na mg kg^{-1}	521.13	337.9337	—	—	—	—
	ash %	7.51	1.2137	—	—	—	—

Table 5

Means and standard error of means of macro- and microelement concentrations and comparison of mean values in the fractions of Cornus sanguinea of oak forest (n = 5)

Fraction		$\bar{x}$	s	One-year-old branch	Stem	Primary root	Root-hair
				$SD_{5\%}$			
Leaf	N %	1.690	0.4124	0.545+	0.520**	0.517**	0.517+
	P %	0.210	0.0384	NS	0.050**	0.050**	0.046*
	K %	1.095	0.2520	0.284***	0.314**	0.320**	0.291**
	Ca %	1.271	0.1152	0.136***	0.129***	0.156***	0.284***
	Mg %	0.345	0.1033	0.136*	0.128**	0.131**	0.120*
	Fe mg kg^{-1}	291.58	66.8730	86.86**	88.56**	80.32**	396.24**
	Mn mg kg^{-1}	88.61	12.9324	16.72***	16.94***	15.45***	48.38***
	Cu mg kg^{-1}	4.18	0.9975	1.19+	1.35**	1.12***	9.67*
	Zn mg kg^{-1}	14.97	3.6842	NS	4.39**	4.19**	18.60*
	Na mg kg^{-1}	29.03	14.1592	15.58*	NS	25.41+	48.61**
	ash %	10.89	2.3926	3.03**	3.01**	3.07**	2.88*
One-year-old branch	N %	1.254	0.1482	—	0.166***	0.197***	NS
	P %	0.232	0.0316	—	0.042***	0.037***	0.039***
	K %	0.369	0.1088	—	0.139*	0.125*	NS
	Ca %	0.540	0.0657	—	0.083***	0.085***	NS
	Mg %	0.144	0.0368	—	0.047**	0.047+	0.067*
	Fe mg kg^{-1}	102.65	20.2140	—	32.84*	NS	388.23**
	Mn mg kg^{-1}	27.32	3.7064	—	5.86*	8.63**	45.87***
	Cu mg kg^{-1}	5.24	0.5671	—	1.05***	0.73***	9.62*
	Zn mg kg^{-1}	18.69	6.4854	—	8.49*	8.33*	15.69**
	Na mg kg^{-1}	48.23	5.2009	—	NS	NS	45.78**
	ash %	3.62	0.4682	—	0.60***	NS	1.87***
Stem	N %	0.526	0.0650	—	—	NS	0.081***
	P %	0.061	0.0110	—	—	0.018*	0.025***
	K %	0.146	0.0209	—	—	0.072*	0.158**
	Ca %	0.291	0.0482	—	—	NS	0.314+
	Mg %	0.040	0.0035	—	—	0.017***	0.067**
	Fe mg kg^{-1}	63.14	24.5326	—	—	48.18*	388.62**
	Mn mg kg^{-1}	20.45	4.2921	—	—	8.91***	45.94***
	Cu mg kg^{-1}	2.11	0.8485	—	—	NS	9.65*
	Zn mg kg^{-1}	5.89	2.1210	—	—	NS	17.28**
	Na mg kg^{-1}	37.21	14.0612	—	—	NS	48.57**
	ash %	2.08	0.3453	—	—	0.73*	1.83**

Primary root	N %	0.472	0.0536	—	—	—	0.072***
	P %	0.086	0.0142	—	—	—	0.025***
	K %	0.236	0.0541	—	—	—	0.143**
	Ca %	0.347	0.0500	—	—	—	0.317+
	Mg %	0.103	0.0138	—	—	—	0.067**
	Fe mg kg^{-1}	119.49	39.6639	—	—	—	390.55**
	Mn mg kg^{-1}	42.12	23.6640	—	—	—	46.57***
	Cu mg kg^{-1}	1.70	0.4125	—	—	—	9.61*
	Zn mg kg^{-1}	5.94	1.6874	—	—	—	17.20**
	Na mg kg^{-1}	51.84	20.1074	—	—	—	43.00**
	ash %	3.12	0.6147	—	—	—	1.61***
Root hair	N %	1.233	0.0453	—	—	—	—
	P %	0.144	0.0215	—	—	—	—
	K %	0.465	0.1265	—	—	—	—
	Ca %	0.633	0.2489	—	—	—	—
	Mg %	0.222	0.0525	—	—	—	—
	Fe mg kg^{-1}	1222.11	311.6172	—	—	—	—
	Mn mg kg^{-1}	255.42	36.7040	—	—	—	—
	Cu mg kg^{-1}	15.20	7.7175	—	—	—	—
	Zn mg kg^{-1}	50.23	13.7315	—	—	—	—
	Na mg kg^{-1}	127.54	36.4488	—	—	—	—
	ash %	7.28	1.4322	—	—	—	—

Table 6

Means and standard error of means of macro- and microelement concentrations and comparison of mean values in the fractions of Cornus sanguinea of forest edge (n = 5)

Fraction		$\bar{x}$	s	One-year-old branch	Stem	Primary root	Root-hair
				$SD_{5\%}$			
Leaf	N %	1.808	0.2411	0.305*	0.273***	0.314***	0.314**
	P %	0.210	0.0613	NS	0.078**	0.074*	0.081+
	K %	1.096	0.1469	0.173***	0.186***	0.186***	0.256***
	Ca %	1.357	0.2104	0.275**	0.264***	0.272***	0.270**
	Mg %	0.390	0.0582	0.067***	0.072***	0.075***	0.072***
	Fe mg kg^{-1}	281.73	37.9798	51.07***	42.59***	51.57***	175.08***
	Mn mg kg^{-1}	82.12	29.2557	38.15*	37.02**	37.83*	74.63***
	Cu mg kg^{-1}	5.81	1.2481	1.42**	1.41+	1.68*	3.23***
	Zn mg kg^{-1}	29.16	5.3733	NS	6.77***	6.86***	18.57**
	Na mg kg^{-1}	31.72	12.8736	19.62**	17.14*	19.89**	106.87*
	ash %	14.18	2.1385	2.69***	2.67***	2.71***	2.47***
One-year-old branch	N %	1.442	0.1713	—	0.210***	0.194***	0.194***
	P %	0.241	0.0454	—	0.058**	0.060**	0.053**
	K %	0.519	0.0830	—	0.108***	0.111**	NS
	Ca %	0.724	0.0670	—	0.089***	0.095***	0.085*
	Mg %	0.172	0.0272	—	0.036***	0.032***	0.046*
	Fe mg kg^{-1}	124.19	31.6412	—	36.65**	NS	173.13***
	Mn mg kg^{-1}	27.08	9.2681	—	11.16*	NS	82.92**
	Cu mg kg^{-1}	2.82	0.5698	—	0.81**	0.79**	3.64***
	Zn mg kg^{-1}	35.31	6.5905	—	8.27***	8.34***	15.93***
	Na mg kg^{-1}	67.62	13.9581	—	NS	NS	107.08*
	ash %	4.49	0.3526	—	0.52***	0.55***	1.39*
Stem	N %	0.482	0.1079	—	—	NS	0.136***
	P %	0.073	0.0124	—	—	0.047+	0.028***
	K %	0.147	0.0238	—	—	0.042*	0.250*
	Ca %	0.286	0.0234	—	—	NS	0.055***
	Mg %	0.046	0.0085	—	—	0.018***	0.044***
	Fe mg kg^{-1}	63.92	16.0423	—	—	23.90**	169.77***
	Mn mg kg^{-1}	13.94	5.5461	—	—	10.37*	82.40**
	Cu mg kg^{-1}	4.52	0.5390	—	—	NS	3.63***
	Zn mg kg^{-1}	7.45	0.8721	—	—	NS	17.36***
	Na mg kg^{-1}	55.07	4.9364	—	—	NS	105.85*
	ash %	1.97	0.2226	—	—	0.47	1.35**

Primary root	N %	0.581	0.0770	—	—	—	0.111***
	P %	0.115	0.0361	—	—	—	NS
	K %	0.198	0.0319	—	—	—	0.250**
	Ca %	0.294	0.0623	—	—	—	0.083***
	Mg %	0.087	0.0167	—	—	—	0.042***
	Fe mg kg^{-1}	111.81	16.6723	—	—	—	141.19***
	Mn mg kg^{-1}	26.81	8.3723	—	—	—	82.77**
	Cu mg kg^{-1}	3.98	0.5182	—	—	—	3.63***
	Zn mg kg^{-1}	6.29	1.2420	—	—	—	17.40***
	Na mg kg^{-1}	63.82	14.3190	—	—	—	107.16*
	ash %	2.66	0.3984	—	—	—	1.41**
Root hair	N %	0.947	0.0755	—	—	—	—
	P %	0.134	0.0233	—	—	—	—
	K %	0.506	0.1995	—	—	—	—
	Ca %	0.612	0.0492	—	—	—	—
	Mg %	0.226	0.0356	—	—	—	—
	Fe mg kg^{-1}	1127.89	135.6095	—	—	—	—
	Mn mg kg^{-1}	255.41	66.0476	—	—	—	—
	Cu mg kg^{-1}	16.52	2.8714	—	—	—	—
	Zn mg kg^{-1}	77.99	13.9395	—	—	—	—
	Na mg kg^{-1}	198.07	84.9931	—	—	—	—
	ash %	6.11	1.0592	—	—	—	—

Table 7

Means and standard error of means of macro- and microelement concentrations and comparison of mean values in the fractions of Cornus sanguinea of shrub hedge (n = 5)

Fraction		x̄	s	One-year-old branch	Stem	Primary root	Root-hair
				SD5%			
Leaf	N %	1.317	0.1449	NS	0.162***	0.222***	0.178***
	P %	0.206	0.0237	NS	0.028***	0.030***	0.030***
	K %	0.955	0.4488	NS	0.559*	0.564**	0.567+
	Ca %	1.603	0.1619	0.189***	0.180***	0.201***	0.214***
	Mg %	0.341	0.0523	0.060***	0.067***	0.067***	0.076**
	Fe mg kg^{-1}	265.03	29.6967	36.19***	37.48***	37.81***	193.34***
	Mn mg kg^{-1}	34.97	3.9555	4.47***	5.14***	6.13***	10.83***
	Cu mg kg^{-1}	5.41	1.1393	1.99**	1.27***	1.41+	31.96*
	Zn mg kg^{-1}	20.82	1.8161	NS	3.67***	2.90***	16.49**
	Na mg kg^{-1}	44.90	11.0304	29.41*	14.02*	NS	27.29+
	ash %	15.36	0.9902	1.34***	1.14***	1.35***	1.29***
One-year-old branch	N %	1.178	0.1607	—	0.214**	0.233***	0.192***
	P %	0.196	0.0216	—	0.025***	0.030***	0.028***
	K %	0.540	0.0654	—	0.076***	0.092***	0.109*
	Ca %	0.778	0.0845	—	0.112***	0.143***	0.106*
	Mg %	0.143	0.0242	—	0.028***	0.028***	NS
	Fe mg kg^{-1}	132.00	18.5810	—	28.85***	NS	191.18***
	Mn mg kg^{-1}	16.93	1.7395	—	2.18***	5.90*	12.25***
	Cu mg kg^{-1}	8.90	1.5487	—	2.01***	1.78***	31.99*
	Zn mg kg^{-1}	29.29	9.4735	—	12.38**	12.07***	16.73**
	Na mg kg^{-1}	81.33	26.2480	—	32.76**	34.37*	NS
	ash %	5.83	0.8296	—	0.99***	1.23***	1.16+
Stem	N %	0.526	0.0596	—	—	NS	0.116**
	P %	0.078	0.0117	—	—	NS	0.021***
	K %	0.223	0.0312	—	—	NS	0.108**
	Ca %	0.315	0.0673	—	—	NS	0.092***
	Mg %	0.033	0.0119	—	—	0.016*	0.067**
	Fe mg kg^{-1}	69.00	20.8448	—	—	27.10**	191.54***
	Mn mg kg^{-1}	5.79	1.2003	—	—	NS	12.15***
	Cu mg kg^{-1}	2.51	0.4668	—	—	0.92**	31.94*
	Zn mg kg^{-1}	6.81	3.0560	—	—	NS	16.77**
	Na mg kg^{-1}	24.73	2.3387	—	—	NS	29.98*
	ash %	2.24	0.4889	—	—	NS	0.93***

Primary root	N %	0.475	0.1589	—	—	—	0.192*
	P %	0.089	0.0179	—	—	—	0.025**
	K %	0.188	0.0603	—	—	—	0.104**
	Ca %	0.263	0.1094	—	—	—	0.129***
	Mg %	0.054	0.0101	—	—	—	0.067**
	Fe mg kg^{-1}	124.89	15.9232	—	—	—	190.81***
	Mn mg kg^{-1}	7.93	4.4175	—	—	—	11.01***
	Cu mg kg^{-1}	4.21	0.7593	—	—	—	31.95**
	Zn mg kg^{-1}	4.77	2.1385	—	—	—	16.55**
	Na mg kg^{-1}	34.40	20.4350	—	—	—	32.56*
	ash %	2.91	0.8537	—	—	—	1.18***
Root-hair	N %	0.702	0.0949	—	—	—	—
	P %	0.127	0.0162	—	—	—	—
	K %	0.406	0.0811	—	—	—	—
	Ca %	0.649	0.0593	—	—	—	—
	Mg %	0.188	0.0519	—	—	—	—
	Fe mg kg^{-1}	1219.02	152.6443	—	—	—	—
	Mn mg kg^{-1}	65.92	9.7022	—	—	—	—
	Cu mg kg^{-1}	47.21	25.6827	—	—	—	—
	Zn mg kg^{-1}	55.54	13.1366	—	—	—	—
	Na mg kg^{-1}	67.73	24.0013	—	—	—	—
	ash %	6.98	0.7540	—	—	—	—

Table 8

The concentration factor of the elements (in plant) concentration

	Fraction	N	K	Ca
				Ligustrum vulgare
Oak forest	leaf	$5.90 \cdot 10^2$	$1.41 \cdot 10^1$	$3.03 \cdot 10^0$
	one-year-old branch	$3.11 \cdot 10^2$	$8.19 \cdot 10^1$	$7.08 \cdot 10^{-1}$
	stem	$1.73 \cdot 10^2$	$1.85 \cdot 10^1$	$4.17 \cdot 10^{-1}$
	primary root	$2.18 \cdot 10^2$	$2.91 \cdot 10^1$	$4.70 \cdot 10^{-1}$
	root-hair	$2.79 \cdot 10^2$	$6.16 \cdot 10^1$	$8.59 \cdot 10^{-1}$
Forest edge	leaf	$3.64 \cdot 10^2$	$4.83 \cdot 10^1$	$2.25 \cdot 10^0$
	one-year-old branch	$2.12 \cdot 10^2$	$3.57 \cdot 10^1$	$3.67 \cdot 10^{-1}$
	stem	$8.28 \cdot 10^1$	$7.22 \cdot 10^0$	$2.41 \cdot 10^{-1}$
	primary root	$1.21 \cdot 10^2$	$1.17 \cdot 10^1$	$2.71 \cdot 10^{-1}$
	root-hair	$2.12 \cdot 10^2$	$1.28 \cdot 10^1$	$5.30 \cdot 10^{-1}$
Shrub hedge	leaf	$8.04 \cdot 10^2$	$9.16 \cdot 10^1$	$2.85 \cdot 10^0$
	one-year-old branch	$4.59 \cdot 10^2$	$9.27 \cdot 10^1$	$4.00 \cdot 10^{-1}$
	stem	$2.17 \cdot 10^2$	$2.44 \cdot 10^1$	$3.28 \cdot 10^{-1}$
	primary root	$2.38 \cdot 10^2$	$3.15 \cdot 10^1$	$3.39 \cdot 10^{-1}$
	root-hair	$4.26 \cdot 10^2$	$9.57 \cdot 10^1$	$5.96 \cdot 10^{-1}$
				Cornus sanguinea
Oak forest	leaf	$4.06 \cdot 10^2$	$7.45 \cdot 10^1$	$4.20 \cdot 10^0$
	one-year-old branch	$3.01 \cdot 10^2$	$2.51 \cdot 10^1$	$1.79 \cdot 10^0$
	stem	$1.26 \cdot 10^2$	$9.94 \cdot 10^0$	$9.62 \cdot 10^{-1}$
	primary root	$1.13 \cdot 10^2$	$1.61 \cdot 10^1$	$1.15 \cdot 10^0$
	root-hair	$2.96 \cdot 10^2$	$3.17 \cdot 10^1$	$2.09 \cdot 10^0$
Forest edge	leaf	$3.10 \cdot 10^2$	$4.33 \cdot 10^1$	$3.17 \cdot 10^0$
	one-year-old branch	$2.47 \cdot 10^2$	$2.05 \cdot 10^1$	$1.69 \cdot 10^0$
	stem	$8.30 \cdot 10^1$	$5.81 \cdot 10^0$	$6.67 \cdot 10^{-1}$
	primary root	$1.00 \cdot 10^2$	$7.82 \cdot 10^0$	$6.86 \cdot 10^{-1}$
	root-hair	$1.63 \cdot 10^2$	$1.99 \cdot 10^1$	$1.43 \cdot 10^0$
Shrub edge	leaf	$5.94 \cdot 10^2$	$1.26 \cdot 10^2$	$3.26 \cdot 10^0$
	one-year-old branch	$5.32 \cdot 10^2$	$7.14 \cdot 10^1$	$1.58 \cdot 10^0$
	stem	$2.37 \cdot 10^2$	$2.95 \cdot 10^1$	$6.41 \cdot 10^{-1}$
	primary root	$2.14 \cdot 10^2$	$2.49 \cdot 10^1$	$5.35 \cdot 10^{-1}$
	root-hair	$3.17 \cdot 10^2$	$5.37 \cdot 10^1$	$1.32 \cdot 10^0$

in soil in the fractions of Ligustrum vulgare and Cornus sanguinea

Mg	Fe	Mn	Cu	Zn	Na
$5.70 \cdot 10^{0}$	$2.91 \cdot 10^{1}$	$2.13 \cdot 10^{-1}$	$8.11 \cdot 10^{0}$	$3.85 \cdot 10^{0}$	$1.27 \cdot 10^{0}$
$2.13 \cdot 10^{0}$	$1.55 \cdot 10^{1}$	$4.71 \cdot 10^{-2}$	$1.00 \cdot 10^{1}$	$3.26 \cdot 10^{0}$	$6.52 \cdot 10^{0}$
$8.51 \cdot 10^{-1}$	$5.51 \cdot 10^{0}$	$2.48 \cdot 10^{-2}$	$5.45 \cdot 10^{0}$	$1.75 \cdot 10^{0}$	$4.64 \cdot 10^{0}$
$1.32 \cdot 10^{0}$	$2.14 \cdot 10^{1}$	$7.09 \cdot 10^{-2}$	$9.37 \cdot 10^{0}$	$1.54 \cdot 10^{0}$	$9.14 \cdot 10^{0}$
$3.15 \cdot 10^{0}$	$1.08 \cdot 10^{2}$	$2.36 \cdot 10^{-1}$	$2.72 \cdot 10^{1}$	$2.77 \cdot 10^{0}$	$7.55 \cdot 10^{1}$
$6.19 \cdot 10^{0}$	$2.72 \cdot 10^{1}$	$1.92 \cdot 10^{-1}$	$6.99 \cdot 10^{0}$	$2.35 \cdot 10^{0}$	$1.13 \cdot 10^{1}$
$2.41 \cdot 10^{0}$	$1.52 \cdot 10^{1}$	$4.13 \cdot 10^{-2}$	$1.50 \cdot 10^{1}$	$2.84 \cdot 10^{0}$	$1.02 \cdot 10^{1}$
$8.62 \cdot 10^{-1}$	$1.28 \cdot 10^{1}$	$1.60 \cdot 10^{-2}$	$5.27 \cdot 10^{0}$	$1.16 \cdot 10^{0}$	$4.10 \cdot 10^{0}$
$1.50 \cdot 10^{0}$	$1.34 \cdot 10^{1}$	$3.85 \cdot 10^{-2}$	$7.26 \cdot 10^{0}$	$1.32 \cdot 10^{0}$	$4.43 \cdot 10^{0}$
$4.13 \cdot 10^{0}$	$1.56 \cdot 10^{2}$	$1.29 \cdot 10^{-1}$	$3.89 \cdot 10^{1}$	$3.04 \cdot 10^{0}$	$6.86 \cdot 10^{1}$
$8.54 \cdot 10^{0}$	$3.71 \cdot 10^{2}$	$3.19 \cdot 10^{0}$	$2.33 \cdot 10^{1}$	$5.02 \cdot 10^{1}$	$5.46 \cdot 10^{0}$
$3.14 \cdot 10^{0}$	$2.21 \cdot 10^{2}$	$5.65 \cdot 10^{-1}$	$3.75 \cdot 10^{1}$	$2.98 \cdot 10^{1}$	$1.30 \cdot 10^{1}$
$9.45 \cdot 10^{-1}$	$1.44 \cdot 10^{2}$	$2.25 \cdot 10^{-1}$	$1.31 \cdot 10^{1}$	$1.47 \cdot 10^{1}$	$2.79 \cdot 10^{0}$
$1.64 \cdot 10^{0}$	$2.06 \cdot 10^{2}$	$2.96 \cdot 10^{-1}$	$1.67 \cdot 10^{1}$	$1.32 \cdot 10^{1}$	$4.68 \cdot 10^{0}$
$5.17 \cdot 10^{0}$	$3.23 \cdot 10^{3}$	$1.25 \cdot 10^{0}$	$1.52 \cdot 10^{2}$	$2.80 \cdot 10^{1}$	$4.99 \cdot 10^{1}$
$6.49 \cdot 10^{0}$	$2.42 \cdot 10^{1}$	$7.35 \cdot 10^{-2}$	$4.98 \cdot 10^{0}$	$1.48 \cdot 10^{0}$	$3.53 \cdot 10^{0}$
$2.71 \cdot 10^{0}$	$8.53 \cdot 10^{0}$	$2.27 \cdot 10^{-2}$	$6.24 \cdot 10^{0}$	$1.85 \cdot 10^{0}$	$5.88 \cdot 10^{0}$
$7.53 \cdot 10^{-1}$	$5.24 \cdot 10^{0}$	$1.70 \cdot 10^{-2}$	$2.51 \cdot 10^{0}$	$5.82 \cdot 10^{-1}$	$4.53 \cdot 10^{0}$
$1.94 \cdot 10^{0}$	$9.92 \cdot 10^{0}$	$3.49 \cdot 10^{-2}$	$2.02 \cdot 10^{0}$	$5.87 \cdot 10^{-1}$	$6.31 \cdot 10^{0}$
$4.18 \cdot 10^{0}$	$1.02 \cdot 10^{2}$	$2.12 \cdot 10^{-1}$	$1.81 \cdot 10^{1}$	$4.96 \cdot 10^{0}$	$1.55 \cdot 10^{1}$
$8.30 \cdot 10^{0}$	$3.33 \cdot 10^{1}$	$6.36 \cdot 10^{-2}$	$5.99 \cdot 10^{0}$	$2.38 \cdot 10^{0}$	$3.41 \cdot 10^{0}$
$3.66 \cdot 10^{0}$	$1.47 \cdot 10^{1}$	$2.10 \cdot 10^{-2}$	$2.91 \cdot 10^{0}$	$2.88 \cdot 10^{0}$	$7.28 \cdot 10^{0}$
$9.79 \cdot 10^{-1}$	$7.55 \cdot 10^{0}$	$1.08 \cdot 10^{-2}$	$4.66 \cdot 10^{0}$	$6.07 \cdot 10^{-1}$	$5.93 \cdot 10^{0}$
$1.85 \cdot 10^{0}$	$1.32 \cdot 10^{1}$	$2.08 \cdot 10^{-2}$	$4.10 \cdot 10^{0}$	$5.12 \cdot 10^{-1}$	$6.87 \cdot 10^{0}$
$4.81 \cdot 10^{0}$	$1.33 \cdot 10^{2}$	$1.98 \cdot 10^{-1}$	$1.70 \cdot 10^{1}$	$6.35 \cdot 10^{0}$	$2.13 \cdot 10^{1}$
$1.66 \cdot 10^{1}$	$8.83 \cdot 10^{2}$	$1.03 \cdot 10^{0}$	$2.25 \cdot 10^{1}$	$8.01 \cdot 10^{1}$	$5.59 \cdot 10^{0}$
$6.96 \cdot 10^{0}$	$4.40 \cdot 10^{2}$	$4.97 \cdot 10^{-1}$	$3.71 \cdot 10^{1}$	$1.13 \cdot 10^{2}$	$1.01 \cdot 10^{1}$
$1.61 \cdot 10^{0}$	$2.30 \cdot 10^{2}$	$1.70 \cdot 10^{-1}$	$1.05 \cdot 10^{1}$	$2.62 \cdot 10^{1}$	$3.08 \cdot 10^{0}$
$2.63 \cdot 10^{0}$	$4.16 \cdot 10^{2}$	$2.33 \cdot 10^{-1}$	$1.75 \cdot 10^{1}$	$1.84 \cdot 10^{1}$	$4.28 \cdot 10^{0}$
$9.15 \cdot 10^{0}$	$4.06 \cdot 10^{3}$	$1.93 \cdot 10^{0}$	$1.97 \cdot 10^{2}$	$2.14 \cdot 10^{2}$	$8.43 \cdot 10^{0}$

The analysis of the soil samples covered the following characteristics; pH, organic matter, total-N, $NH_4 + NO_3$, 0.1 n hydrochloric acid soluble K, Ca, Mg, Fe, Mn, Cu, Zn, Na (ratio of soil to solvent was 1 : 5).

The mean and standard error of the mean of the element concentrations of soil in contact with the roots of two shrubs are summarized in Table 1.

The element concentration mean values and the standard error of data for the *Ligustrum vulgare* fractions are contained in Tables 2, 3, and 4, and those of *Cornus sanguinea* fractions in Tables 5, 6 and 7.

The element concentrations in the various fractions of the shrubs, and to the estimate the level of significance of differences in the means. The *t* test was used to compare (Sváb 1973). These data are given in Tables 2—7.

Results

The distribution of elements within shrubs

The concentration of all the elements in the root system of the two shrub species is significantly higher in the root-hairs than in the primary ones, while in their shoot system concentration increases as follows: stem — one year-old branches — leaves order (Tables 2—7).

The stem and primary root do not significantly differ with regard to most of the elements.

The maximum macroelement accumulation is to be found in the leaves.

In both species, the macroelement content of the leaves significantly differ from those of the primary root fractions.

There is a relatively high concentration of macroelements in the one year-old branches and the root-hairs, besides the leaves. The N, P and K content of the one year old branches mostly does not differ significantly from that of the root-hairs and it shows a great similarity also to that of the leaves.

The two shrub species essentially differ in their accumulation of K and Ca *Cornus sanguinea* takes up and utilizes Ca to a greater extent than K, thus the ratio of potassium and Ca concentration in its fractions is below 1, and the fluctuation of this among the fractions is small (0.5—0.9). On the other hand, in the fractions of *Ligustrum vulgare*, which accumulates K in a high concentration, the ratio K : Ca is higher than 1 and changes among the fractions in a higher proportion. The ratio K : Ca is low in the fractions stem and primary root (2—3), as well as leaf (1—2), while in the one-year-old branches it is very high (6—7). The K : Ca ratio in the root-hairs approaches that of the one-year-old branches (4—5).

Similar to potassium, there is also a higher concentration of magnesium in the fractions of *Cornus sanguinea* (Table 1).

In contrast with the macroelements, the accumulation of the microelements (Fe, Mn, Zn and Cu) is higher in the fractions of *Ligustrum vulgare* (Tables 2, 3 and 4).

In the individuals of both shrub species the microelements — but mainly Fe — have their concentration maximum in the root-hairs, but —

compared with the primary root fractions — they can be found in a much higher concentration also in the leaves and the one-year-old branches.

The two shrub species are different also from the viewpoint of microelement distribution within the plant. *Cornus sanguinea* accumulates the microelements taken up from the soil in its root-hairs (Tables 5, 6 and 7), from there their transportation towards the leaf is minimal thus the root hairs differ significantly from all the fractions. The distribution of microelements (mainly Mn, Zn and Cu) in the individuals of *Ligustrum vulgare* is more balanced; the accumulation in the one-year-old branches and in the leaves is of an identical value or surpassing that in the root-hairs.

Of the four microelements, the concentration of Fe is especially high in the root-hairs (above 1000 ppm), it surpasses the Fe-content of the leaves several times (200—300 ppm). Shrubs in their prefer Fe to Mn being present in the soil at a higher concentration (Table 1). Owing to a higher Mn uptake, a smaller Fe : Mn ratio is characteristic of the individuals of *Ligustrum vulgare*.

Nutrient utilization in shrubs

It appears from the values expressing the nutrient utilization (element concentration in plant: concentration in soil; see Table 8), that the concentration of elements in plants is decidedly influenced by the activity and selectivity of the plant. In relation to concentration factors, a differentiation in groups of macro- and microelements is difficult because the concentration factor of certain microelements, and it can even be higher than that. In the leaf fractions, one-year-old branch and root-hair of the two shrub species examined, the concentration factor values were high in relation to all the elements.

A high accumulation in the plant is characteristic of N, Fe and K; the concentration factor of N is of a 10^2 order of magnitude in all the fractions; that of Fe is 10^0—10^3; that of potassium varies between orders of magnitude 10^0—10^2, depending on the fraction. In the case of Zn, Cu, Na and Mg, accumulation is smaller by one order of magnitude (10^0—10^1).

In spite of the high concentration in the soil (Table 1), the utilization of Ca is unsatisfactory, the concentration factor values are of 10^0 and 10^{-1} order of magnitude. Of the microelements, Mn is contained in the soil, at the highest concentration, still it is utilized in the plant at the lowest value (10^{-2}—10^{-1} order of magnitude).

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Acta Botanica Academiae Scientiarum Hungaricae, Tomus 27 (1—2), pp. 141—150 (1981)

THE EFFECT OF *LEPIDOPTERA* LARVAE CONSUMPTION ON THE LEAF PRODUCTION OF *QUERCUS PETRAEA* (MATT.) LIEBL.*

By

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(Received 28 Dec. 1979)

The consumption by *Lepidoptera* larvae chewing the leaves of *Quercus petraea* (MATT.) LIEBL. in relation of the annual leaf production was investigated in sessile-turkey oak forest sampling areas in 1978.

The changes in the larvae number, the quantitative ratio in the litter of shoots destroyed by consumption and the development and ratio of new shoots in the canopy were our concern.

At the end of the vegetation period, from data of 20 sample trees, the ratio of shoots of varying ages was established in the photosynthetizing phytomass, their situation according to level, and their share in annual primary production.

In the year examined, the *Tortrix viridana* caused 60—65% cumulative total damage by consuming the first shoots, mainly in the upper level of the canopy. To compensate for the reduced foliage, second and third shoots grew from the dormant buds. In autumn, the ratio of first shoots in the remaining total leaf phytomass was 24.39%, while that of the new shoots was 75.61%. This quantity, calculated for leaf surface index (S_l/A), gives a value of 1.03 resp. 3.21, altogether 4.24. In our estimations, the first shoots provided 30—50% of the annual primary production, the second shoots 50—70%, while the third shoots, functioning for the shortest time, produced 0—5%. The sessile-turkey oak wood can compensate for a moderate amount of damage caused by phytophagous insects under natural conditions.

Introduction

A multivarious phytophagous organisms feed on a great quantity of organic material accumulated in the vegetation of forests. In temperate forest ecosystems, *Lepidoptera* larvae are wellkown to cause considerable damage.

The damage caused by *Lepidoptera* larvae may be a consequence of several processes. The insects chewing the leaves upset the physiological state of the tree causing a decline in photosynthetic capacity, and has an indirect effect on the growth of the tree (RAFES 1970). The damage caused may manifest itself in the degradation of the forest, or in the deterioration of the material of the damaged tree as well (FRANKLIN 1970). Its total effect is not known enough yet; in many cases it is difficult to be measured.

According to GOLLEY (1972), phytophagous insects in natural forests in general consume less than 10% of the total net primary production. In North-Lancashire, CARLISLE et al. (1966) measured only 3.98 leaf surface index (S_l/A = LAI) on *Tortrix* gradation in 1961, while in the subsequent year the consumption was insignificant, the value of S_l/A increased to 5.47. REICHLE et al. (1973) measured 7.7% leaf surface area reduction in *Liriodendron*

* Síkfőkút Project No. 59.

forest; KACZMAREK and WASILEWSKI (1977) reported a 6.7—36.7% production loss in oaks; BRAY (1964) recorded a 7.4—8.1% moderate annual leaf consumption. CHURCHILL et al. (1964) experienced in a 29-year-old planted *Populus tremuloides* MICHX. stand that after 3 years of strong defoliation, 84% of the trees became destroyed.

In 1973, in the NE part of the USA, the *Limantria dispar* damaged 700,000 ha of hard-wood forests, while other *Lepidoptera* larvae damaged 34.5 million ha pine forests (KETCHAM and SHEA 1977). In NE Pensylvania, between 1970 and 1976, *Limantria* caused 0—67% cumulative tree mortality in white oak forests; the value of the loss was around 187 dollar ha^{-1} (HERRICK, GANSNER and DEBALD 1979). In Canada, in *Abies balsamea* (L.) MILL. defoliation even as high as 70—100% could be experienced (BLAIS 1979).

In Hungary, in the sampling area of the sessile-turkey-oak forest of the Síkfőkút Project (JAKUCS 1978), 15—54% damage was registered between 1973 and 1977 (VIRÁGH 1977).

Our measurements carried out in 1978 were aimed at collecting data on the ratio of participation of leaves growing on shoots of various age groups in the photosynthetic activity of the oak canopy, in the case of moderate damage.

Method

In Síkfőkút Project area the observations and measurements were carried out continually from April 1978 to the end of the vegetation period. In the spring and summer period, part of the leaves damaged by *Lepidoptera* larvae become desiccated and fall into the litter. The material obtained from the 20 litter-collecting boxes of altogether 10 m^2 surface, placed in the area (TÓTH, B. PAPP and JAKUCS 1982), was separated into two fractions. Into one of them were grouped the chewed leaf residues originating from the first shoots of *Quercus petraea* (MATT.) LIEBL., while in the other the remaining litter components. After drying at 85 °C the two fractions were measured.

In the second half of September, 20 pieces of sample trees were randomly marked in the region of the sampling area; branches of different sizes were cut off them so that both the lower and upper levels of the canopy were represented. In one half of the sample trees a considerable quantity of foliage phytomass was worked up: 1/8—2/3 part of the total canopy of the tree. At the site the first, second and third shoots were separated on the basis of morphological characteristics and after the determination of the matura tion of the shoots.

The shoots developing from the buds opening after the winter rest period were classified as first shoots; they appear in masses on the trees in April, and they photosynthetize during the whole vegetation period.

The second shoots developed from newer dormant buds at the end of June and beginning of July. Their leaf surfaces are small; they do not reach the average leaf size until the fall of leaves; the shoots in most cases could not lignify.

The number and the wet weight of the shoots of different ages were recorded after drying at 85 °C when they were weighed again. In this way, we received information on the ratio of the first shoots surviving in the different regions of the canopy during the whole vegetation period, and on the quantity amount of compensatory new shoots developing from the dormant buds. The value of the leaf surface area index of the new shoots and their share in the primary production, were estimated on the basis of average leaf number and phytomass to be found on the shoots.

Results

According to observation of several years mainly *Tortrix viridana* appeared in the sampling area on oak leaves at the end of April and beginning of May. Frequently, *Erannis defoliaria* and *Operophtera brumata* also appear. The gradation of *Limantria dispar* in the mid-June, and of *Cosmia trapezina*

at the end of July and August also occurred (VARGA ex verb.). This is essentially in agreement with the data collected by means of light trap network in Hungary (KERESZTESI 1967).

According to VORONTSOV's examinations (1963), in spring the greatest loss caused by chewing appears in those areas where the growth period is shorter. Here a large part of the damage is caused by *Tortricidae* and *Geometridae* consumption.

The most considerable damage in the year examined was caused by the gradation of *Tortrix viridana*, while the damage caused by other worms was smaller (Table 1). The maximum number of larvae was reached in the beginning

Table 1

Changes in the number of individuals in Lepidoptera larvae on the leaves of Quercus petraea (Matt.) Liebl., in 1978
(On the basis of L. Szabó ined. data)

	No. of larvae individuals, ind. $ha^{-1} \times 10^6$			
	5. IV.	4. V.	1. VI.	30. VI.
Tortricidae	0.079	7.362	7.295	2.442
Noctuidae	0.000	0.060	0.003	0.225
Geometridae	0.000	0.194	0.000	0.000
Total	0.079	7.616	7.298	2.667

of May, then from the beginning of June it began to decrease abruptly. The relatively small assimilation surface of the young, fresh leaves of a few cm in size rapidly decreased. On the foliage surfaces containing a larger number of larvae, even the rapid growth rate of the damaged leaves could not balance the consumption. A considerable part of the damaged leaves decayed after a certain period of time, then — after the formation of the separating tissue, they dropped into the litter.

The quantitative increase in the leaves of damaged first shoots, and collected monthly from the litter, followed the worm gradation by some 3 weeks' shift, and after a transitional decrease, it reached its maximum in September (Table 2). The transitional decrease can be attributed to the surviving part of the damaged leaves disjointing the shoots only in the autumn defoliation period. In spite of the considerable phase shift, there is a correlation between the quantity of the first shoots falling into the litter and the number of larva individuals (Fig. 1).

According to our measurements, the consumption on the first shoots was 20%. Since, owing to leaf growth, the lack in organic matter consumed also increases (NAGY 1978), the damage caused in the assimilation surface

Table 2

The ratio of litter originating from the chewed first shoots of Quercus petraea (Matt.) Liebl. to the total litter weight in 1978

Period	Dry weight of total litter quantity, kg ha^{-1}	Dry weight, kg ha^{-1}	Ratio to the total litter weight, %
		of the chewed firts shoots found in the litter	
1. V. —1. VI.	145.37	3.83	2.63
1. VI. —1. VII.	389.76	43.76	11.23
1. VII. —1. VIII.	230.47	28.45	12.34
1. VIII.—1. IX.	415.30	23.19	5.58
1. IX. —1. X.	578.80	89.74	15.50
1. V. —1. X. total	1759.70	188.97	10.74
Total in 1978	5628.76	861.63	15.30

area is considerably more than that. *Tortrix* chews off the main rib of the leaf, thus the cumulative total damage was estimated at 60—65%. The damage appeared primarily in the upper part of the foliage, thus the light leaves became damaged to the greatest extent, i.e. those according to RAFES (1970) which produce a large part of the organic matter.

To compensate for the reduced leaf area, the second shoots gradually developed from the dormant buds, at the beginning and in the middle of May and had their maximum leaf area as early as the end of June and beginning of July. From the middle of June, third shoots started to develop at low
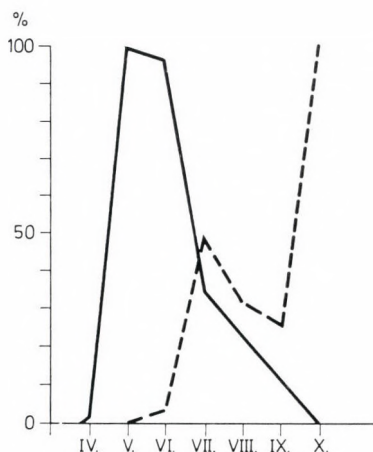
Fig. 1. Distribution of the number of *Lepidoptera* larvae individuals (unbroken line), and the quantity of damaged first shoots fallen into the litter (broken line), between 1. IV and 1. X of 1978

intensity. The total phytomass of these in comparison with the others was not significant and their assimilation activity was also strongly restricted due to the damage by powdery mildew (Fig. 2).

In the second half of September 1978, we cut off one branch from each of the 20 sample trees, the diameter of which was between 3.2 and 16.8 cm;
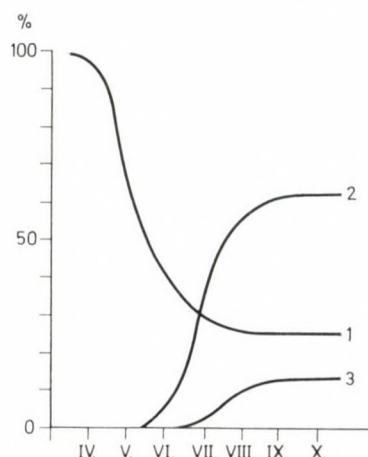
Fig. 2. Changes in the quantitative proportions of the shoots of different age classes in the canopy between 1. IV. 1978 and 1. X. 1978. Percentage rations of *1* = first shoots; *2* = second shoots; 3 = third shoots (1 + 2 + 3 = 100%)

their length changed between 2.1—8.7 m. The largest branch comprised two thirds of the whole canopy; on this branch there were only 745 damaged first shoots, and on the other hand 3898 new shoots were found on it. Their weight ratio was 13.27% resp. 86.73% (Fig. 3).

No living first shoot was found on tree branches. Each of these originated from the upper layer of the canopy, and here were numerous new shoots (632, 982 and 1025). It was only on five branches where a quantity beyond 50% of first shoots survived (57.40—82.60%) these however — with the exception of one — gave essentially lower production in dry weight than their percentage value related to the number of pieces (Table 3).

By taking the data on branches lying in the lower layer (shade), and those in the upper (light) layer separately, it seems that the first shoots on the branches situated in the lower layer produce 33.5% of the total phytomass existing in autumn, while those in the upper position only 15.3%. In the average of the 20 sample trees, the ratio of the first shoots sharing in the photosynthesizing phytomass was 24.39%, while that of the new shoots 75.61% (Fig. 4). This quantity calculated for the index of leaf surface area (S_1/A) amounts to a value of 1.03 resp. 3.21, altogether 4.24. According to the data

Fig. 3. Two thirds of the canopy of the oak shown in the picture were cut down and processed. The arrow indicates the snag
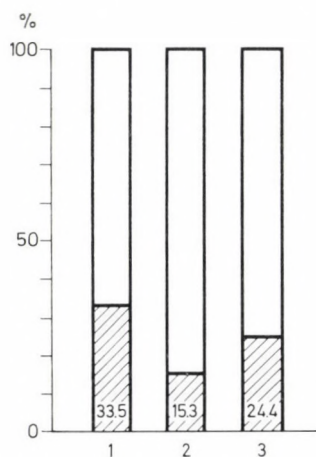
Fig. 4. The ratio of first shoot dry weights in September 1978 (hatched area) to the new shoots (blank area), *1* in the lower branches, *2* in the upper branches of the canopy, *3* on the average of 20 sample trees

Table 3

Shoots of different age classes obtained from the branches of 20 sample trees (IX. 1978)

Serial number	Branch		First shoots			Second and third shoots			Shoot total		Ratio of first shoots	
	Dia, cm	Length, cm	Piece number	Dry weight, g	Average weight of one shoot, g	Piece number	Dry weight, g	Average weight of one shoot, g	Piece number	Dry weight, g	number (to the total, %)	dry weight (to the total, %)
1.	16.8	870	745	599.4	0.80	3,898	3,918.1	1.01	4,643	4,517.5	16.04	13.27
2.	11.6	840	883	1,073.0	1.21	726	677.2	0.93	1,609	1,750.2	54.87	61.30
3.	11.6	410	705	543.1	0.77	1,043	894.8	0.86	1,748	1,437.9	40.33	37.77
4.	11.2	440	330	254.0	0.77	2,502	2,276.7	0.91	2,832	2,530.7	11.65	10.04
5.	11.1	475	115	39.4	0.34	324	394.6	1.21	439	434.0	26.19	9.08
6.	10.2	598	619	458.0	0.74	449	451.7	1.00	1,068	909.7	57.95	50.34
7.	7.1	410	148	115.5	0.78	718	749.3	1.04	866	864.8	17.09	13.35
8.	6.7	310	0	0.0	0.00	1,025	1,282.5	1.25	1,025	1,282.5	0.00	0.00
9.	6.7	260	196	154.3	0.78	362	356.7	0.98	558	511.0	35.12	30.19
10.	6.6	290	80	61.2	0.76	1,247	1,022.8	0.82	1,327	1,084.0	6.03	5.64
11.	6.1	430	304	417.2	1.37	310	424.6	1.36	614	841.8	49.51	49.56
12.	5.9	320	369	428.1	1.16	123	106.0	0.86	492	534.1	75.00	80.15
13.	5.4	300	0	0.0	0.00	982	893.6	0.91	982	893.6	0.00	0.00
14.	5.4	250	116	103.4	0.89	160	142.4	0.89	276	245.8	42.03	42.06
15.	4.8	220	0	0.0	0.00	632	641.7	1.01	632	641.7	0.00	0.00
16.	4.5	285	234	156.9	0.67	139	111.7	0.80	373	268.6	62.73	58.41
17.	4.4	210	55	46.4	0.84	190	142.2	0.74	245	188.6	22.45	24.60
18.	3.8	240	121	91.9	0.76	165	117.1	0.71	286	209.0	42.31	43.97
19.	3.3	235	186	119.8	0.64	138	122.6	0.89	324	242.4	57.40	49.42
20.	3.2	210	182	153.3	0.84	241	196.9	0.82	423	350.2	43.02	43.77
Σ	—	—	5,388	4,814.9	—	15,374	14,923.2	—	20,762	19,738.1	—	—
$\bar{x}$	—	—	269.4	240.74	0.89	768.7	746.16	0.97	1,038.1	986.9	25.95	24.39

available in the literature, the S_1/A value of *Quercus petraea* (MATT.) LIEBL. changes between 4.75 and 5.47 (CARLISLE, BROWN and WHITE 1966), and between 5.98 and 6.69 (JÁRÓ 1959). In the sampling area of the Síkfőkút Project, a value of 1.73 was measured on the average of a 5 year period, in sessile oaks (JAKUCS 1982).

The average dry weight of the new shoots ($W_{D,s}$ = 0.970 g) is greater then the old ones ($W_{D,s}$ = 0.893 g) not only, because the leaves of the new shoots grew to a larger size but also because the old shoots were damaged to a greater extent. There was even such branch where the majority of the leaves that had survived on the first shoots consisted only of the peduncle and some ribs, no complete leaf was found, and even a leaf of maximum size surface area reached 40% of its original size (Fig. 5). True, in a considerable portion of also the new shoots, the damage by larvae — which are of a large number even in June — could be observed (Table 4). This, in ten sample trees was related by 34.94% to the new shoots, but the damage caused did not go beyond 5—10% when the values were taken together.

A high average leaf surface area was measured on the shoots that started to develop earlier, for example on a four-leafed shoot, a total surface area of 115—290 cm², on a five-leaved shoot an area of 90—420 cm². There were 5—6 leaves on the average on a shoot. The photosynthesizing surface area of the shoots that started to grow later was — owing to the shorter growth period, —

Fig. 5. The leaves originating from the strongly damaged first shoots that still existed on the branch in autumn

Table 4

The extent of damage caused in the second shoots developed by July, in 10 sample trees

Number of new shoots	Number of damaged new shoots	%
138	33	23.9
139	36	25.9
241	147	60.9
324	192	59.2
310	157	50.6
362	262	72.3
190	26	13.7
449	63	14.0
726	129	17.8
160	17	10.6
3039	1062	34.94

smaller. The number of third shoots developing the latest, from the end of June, can be significant — it can even reach 30% of the total number of new shoots — nevertheless, their leaf surface area is small. The total surface area of a 11-leafed third shoot hardly reached the size of 20 cm^2!

Microsphaera quercina (SCHWEIN.) BURR. very often causes damage to the new shoots, especially in the lower, shady layers of the canopy, and in the third shoots developing the latest. The photosynthesizing activity of the second shoots, in spite of the damage by powdery mildew, has a significant share in the annual primary production, also because of its large mass.

The third shoots, however, play a subordinate role. This is partly attributable to their low ratio in the phytomass, and partly to the deterioration caused by powdery mildew, and partly to their short life-span. The leaves of the third shoots are not able to develop, the shoots cannot mature in the vegetation period, therefore, a large part of them are destroyed by early frosts. The quantity of assimilates produced by them was probably enough only for supplying the organic matter necessary for their growth.

According to our estimations, the surviving first shoots, since they were able to function during the whole vegetation cycle but their quantitative ratio was smaller, produced 30—50% of the annual primary production; the second shoots of shorter life-span but with a large leaf surface area produced 50—70%; while the third shoots, representing the smallest quantity of phytomass and having the shortest life time, produced 0—5% during the period examined.

On the basis of our results it can be inferred that the sessile oak stand having a natural ecological balance can compensate for the damage caused by phytophagous insects. The secondary producers when moderately damaged by their activity supposedly accelerate the circulation of matter, under their effect the nutrient resources of the forest are mobilized, and the functioning of the canopy regenerated in time, can ensure the organic matter supply necessary for the vegetation period next year.

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Acta Botanica Academiae Scientiarum Hungaricae, Tomus 27 (1—2), pp. 151—160 (1981)

MOSSES OF VIETNAM, II

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(Received: 1. February 1981)

25 moss species are reported from Vietnam collected by the author and deposited in Hanoi and EGR. 3 of them are new to science: *Calymperopsis vietnamensis* NINH, *Calyptrochaeta pocsii* NINH, *Distichophyllum duongii* NINH, and 6 are new to Vietnam: *Distichophyllum montagneanum* (C. MUELL.) V. d. B. et LAC., *Lopidium javanicum* HAMP., *Mnium lycopodioides* SCHWAEGR., *Plagiomnium acutum* (LIND.) KOP., *Pogonatum proliferum* (GRIFF.) MITT., *Symphysodontella tortifolia* DIX. Two new combinations are proposed: *Calyptrochaeta spinosa* (NOG.) NINH and *Wijkia clastrobryoides* (TIX.) NINH.

Following my first paper (TRAN NINH 1981), now I can contribute new records on other Vietnamese mosses collected by myself in recent years. The species new to Vietnam are shown by an asterisk. All the specimens cited in the paper are preserved in the Herbarium of Hanoi Un versity (Hanoi) and in Eger—Vácrátót (EGR).

DICRANACEAE

1. **Wilsoniella decipiens** (MITT.) ALGT., in DIX. in J. Bot., 68: 2, 1930
Tamdao: on bark of tree, 950 m, 69 185. (Distr.: India, Ceylon, China, Vietnam, Java Borneo, Philippines and New Guinea.)

2. **Calymperopsis vietnamensis sp. nov.**
Small, epiphytic, pale yellow tufted plants. Shoots simple, about 2—4 mm high. Leaves erectopatent 2.8—3.20 mm long and 0.65—80 mm wide, curled and falcate when dry, broad lingulate, their apex obtuse. Cancellinae up to 0.8—1.1 mm height, formed by 4—6 rows of pellucid, elongate, quadrate, rectangular, very large (25×35—30×60 μm) cells, which become smaller towards the margin, arranged in 5—6 rows. Chlorophyllose laminal cells small, quadrate, 7.5×8—10×11 μm, pluripapillose. Leaf border narrow and ends below 1/2 length of the leaf. Costa narrow, 0.56—0.60 μm in cross section. Epidermal cells small, rectangular. Stereids 5—7. Gemmae occur along costa, abundant, 320—400 μm long, and 14—22 μm broad, consist of 10—14 cells. Sporophyte not found.

Plantae minutae epiphyticae pallide flavescentes, dense caespitosae. Caulidia simplicia 2—4 mm alta. Phyllidia erecto-patentia, 2.8—3.2 mm longa et 0.65—0.80 mm lata, in sicco falcata et revoluta, apice ipso obtuso. Cancellinae usque ad 0.8—1.1 mm altae, compositae

cellulis magnis (25×35—30×60 μm) elongatis rectangulariter quadratis pellucidis in seriebus 5—6 ordinatis. Cellulae laminares parvae quadratae, 7.5×8—10×11 μm multi- vel unipapillatae. Margo phyllidii e cellulis elongatis formatus sub medio terminatus. Costa tenuis, 0.55—0.60 μm crassa sectione transversali. Cellulae epidermales parvae, rectangulares. Stereida 5—7. Gemmae per totam longitudinem costae abundantes, 320—400 μm longae et 14—22 μm latae 10—14 cellulatae. Sporophytum ignotum.

Tamdao: Tropical lower montane evergreen rain forest, 1000 m (No. 69 275, holotype in Hanoi, on tree trunk, coll. Tr. NINH, 6. 1969). This species is similar to C. semiliber but smaller in size, the leaf borders are narrower and consist of shorter cells, reaches below 1/2 length of the leaf, papillae are fewer and larger; gemmae shorter.

3. Syrrhopodon albidus THW. et MITT., J. Linn. Soc. Bot. 13: 289, 1873. — Tamdao: on bark, 1000 m, 69 178. (Distr.: India, Vietnam, Ceylon, Malay Peninsula, Indonesia.)

4. Syrrhopodon larminatii PAR. et BROTH., Rev. Bryol. 28: 185, 1901. — Tamdao: on decaying wood, 950 m, 69 289. (Distr.: Japan, China, Vietnam, Thailand, Bangladesh, Malaya Peninsula, Philippines, New Guinea.)

5. Mitthyridium flavum (C. MÜLL.) ROBINS., Phytologia 32: 433, 1975. — Tamdao: on tree, 950 m, 69 328. (Distr.: Indonesia, Philippines, Vietnam, Babuyan Isl.)

6.* Mnium lycopodioides SCHWAEGR., Sp. Musc. Suppl. 2 (2): 24, 1826. — Tamdao: on rock, 950 m, 68 194, 73 14. (Distr.: Central and North Europe, North America, North Africa, West Himalaya, Kashmir, West Tibet, China, Taiwan, Japan.)

7.* Plagiomnium acutum (LINDB.) KOP. in Ann. Bot. Fennici 12: 57—58, 1975. — Tamdao: on decaying wood, 1000 m, 69 31, 69 132. Sapa: on bark of tree, 1750 m, 68 27. (Distr.: India, China, Korea, Japan.)

8. Plagiomnium rhynchosporum (HOOK.) KOP. Hikobia 6: 57, 1971. — Tamdao: on tree base 900 m, 69 60, 69 136. (Distr.: India, Nepal, Bhutan, Ceylon, Borneo, Indonesia Philippines, Burma, Thailand, Vietnam, Taiwan.)

9. Plagiomnium rostratum (SCHRAD.) KOP., Ann. Bot. Fennici 5: 147, 1968. — Tamdao: on rock, 950 m, 73 14a. (Distr.: India, Nepal, China, Ceylon, Indonesia, Philippines, Taiwan, Korea, Japan, Africa, North and South America, Australia, New Zealand, and Vietnam.)

10. Plagiomnium succulentum (MITT.) KOP., in Ann. Bot. Fennici 5: 147, 1968. — Tamdao: on rock, 950 m, 69 343, 74 241a. (Distr.: India, Borneo, Nepal, Bhutan, China, Vietnam, Japan, Taiwan, Java, Philippines, New Guinea.)

TRACHYPODIACEAE

11. Trachypus bicolor REIN. et HORSCH. var. **hispidus** (C. MÜLL.) CARD., Beih. Bot. Centralb. 19, 2: 116, 1905. — Tamdao: on tree, 950 m, 67 151. (Distr.: India, Ceylon, China Burma, Vietnam, Laos, Japan, South East Brazil, Tanzania, French Guinea.)

12. Trachypodopsis serrulata (P. BEAUV.) FLEISCH. var. **crispatula** (HOOK.) ZANT. Blumea 9: 521, 1959. — Tamdao: on rock, 68 385b. (Distr.: Himalayas, India, Burma, Laos, Vietnam, Malay Peninsula, Indonesia, Philippines.)

PTEROBRYACEAE

13.* Symphysodontella tortifolia DIX., in J. Bomb. Nat. Hist. Soc. 39: 782, 1937. — Tamdao: on bark of tree, 950 m, 68 163. (Distr.: India.)
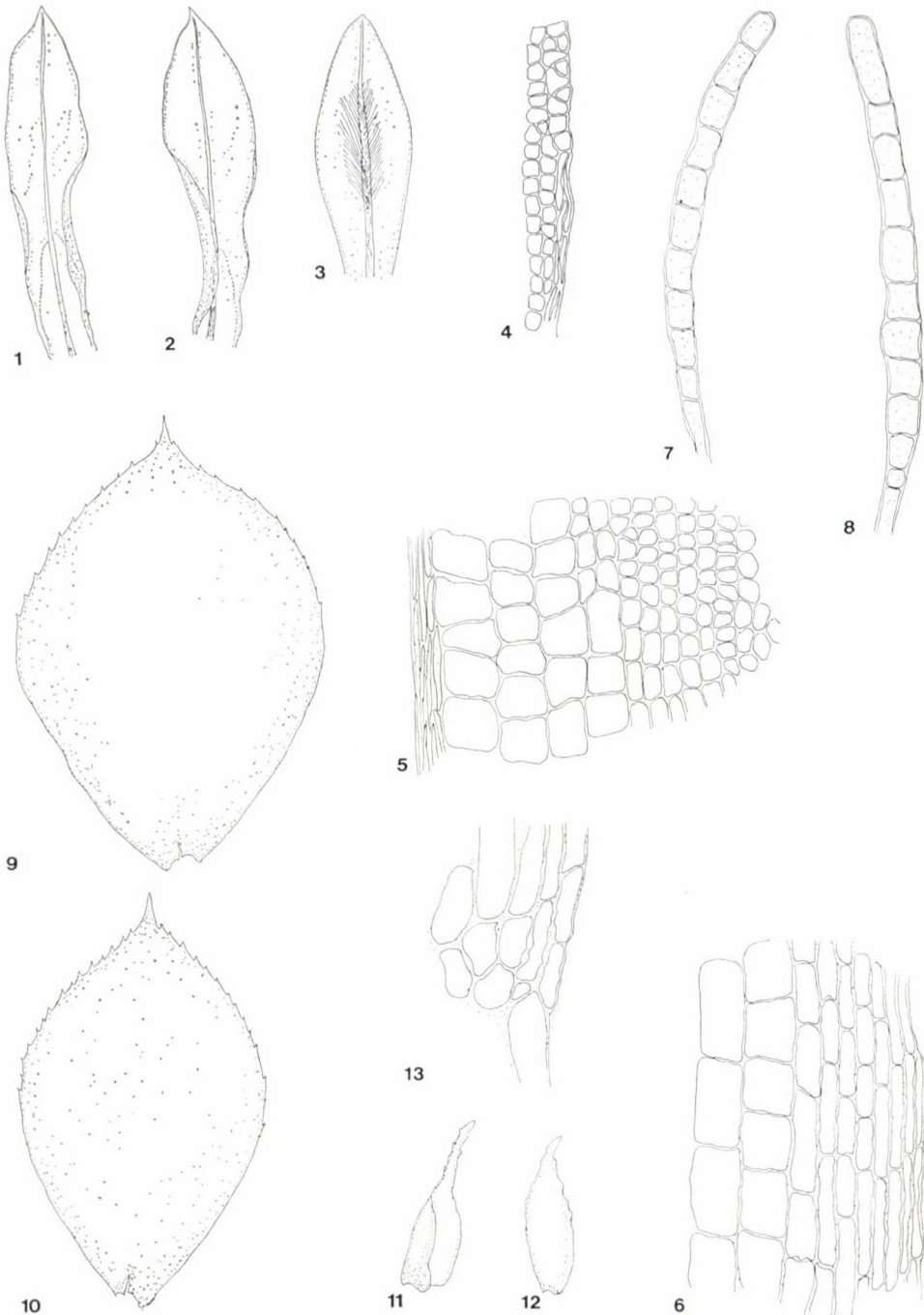
Plate I. *Calymperopsis vietnamensis* (1—8) and *Calyptrochaeta pocsii* (9—13)

1, 2. Leaves, ×20; 3. Ditto, showing gemmae, ×20; 4. Marginal cells, ×270; 5. One half of leaf base at the top of cancellinae, ×270; 6. Leaf base cells, ×270; 7, 8. Gemmae, ×270; 9, 10. Leaves, ×20; 11, 12. Perichaetial leaves, ×63; 13. Leaf alar cells, ×270. All drawn from holotypes

HOOKERIACEAE

14. Distichophyllum duongii sp. nov. (Fig. 2)

Medium sized, pale green, on shady rocks. Stems branched or simple, up to 1.2—1.5 cm. Stem rounded in cross section, measures 180 μm in diam., consists of uniformly hexagonal cells with delicate, brown walls. The epidermal layer is composed of small cells, not much differentiated. Leaves densely erectopatent, more or less complanate, slightly wavy when dry, margin entire, bordered, 1.72 mm long and 0.65 mm wide, oblong, apex rounded with short apicules, symmetrical. Costa single, covering 2/3 of leaf length or ending near the leaf apex. Leaf cells quadrate, hexagonal with thin walls, median cells 15—18×21—30 μm; apex cells 13×15 μm. The cells become slightly larger and rectangular at the base of leaf (55—65×20—25 μm). Margin is entire, slightly revolute and narrowly bordered all-round by 1—2 rows of linear, thick walled, pale yellow cells (by 1 at the middle and by 2 at the lower half of the leaf). Sporophytes are laterally arranged on the stem. Perichaetial leaves few in number, inner ones ovate with a moderately long acumen, slightly concave, ecostate, about 0.8 mm long, the cells lax, with distinct marginal border. Paraphyses few. Seta curved when dry, brown, smooth, about 6—9 mm long. Theca inclined, oblong with a distinct neck, about 1.05× ×0.45 mm. Outer peristome teeth lanceolate, about 0.30 mm long, with dense papillae arranged in rows, densely striated. The inner peristome is pale, its segments are as long as the outer teeth. The exothecial cells are hexagonal with delicate walls, in the corners incrassated, with trigones. Spores globose, papillose, 8—10 μm in diam.

This species is similar to *D. montagneanum*, but smaller in size, its peristome is longer and the spores have papillae on their surface. While the theca cell walls of *D. montagneanum* are indistinctly thickened, on the contrary the new species has collenchymatous exothecial cells.

Plantae statura medianae, pallide virides, in rupibus copertis. Caulidia simplicia vel ramificata usque ad 1.2—1.5 cm longa, teretia in sectione transversali, 180 μm in diametro, e cellulis uniformiter hexagonalibus, parietibus tenuibus brunneis suffultis formata. Stratus epidermalis e cellulis parvis, parum differentiatis compositum. Phyllidia dense erecto-patentia, plus-minus complanata, in sicco leviter undulata, oblongata et marginata, 1.72 mm longa et 0.65 mm lata, margine integra apice rotundata et breviter apiculata, symmetrica. Costa singularis, in 2/3 longitudinis laminae vel proximo sub apice terminata. Cellulae phyllidii quadratae, hexagonales parietibus tenuibus, medianae 15—18×21—30 μm, apicales 13×15 μm, versus basim laminae leviter majores et rectangulares (55—65×20—25 μm). Margo integer, leviter revolutus, e cellulis linearibus, pallide flavis, parietibus crassis suffultis in seriebus 1—2 (medio laminae in serie 1, sub medio in serie 2) dispositis formatus, laminam circumdatus. Sporophyta lateralia; phyllidia perichaetialia pauca, interiora ovata, moderate acuminata, leviter concava, ecostata, cca 0.8 mm longa, distincte marginata, cellulae laxae.
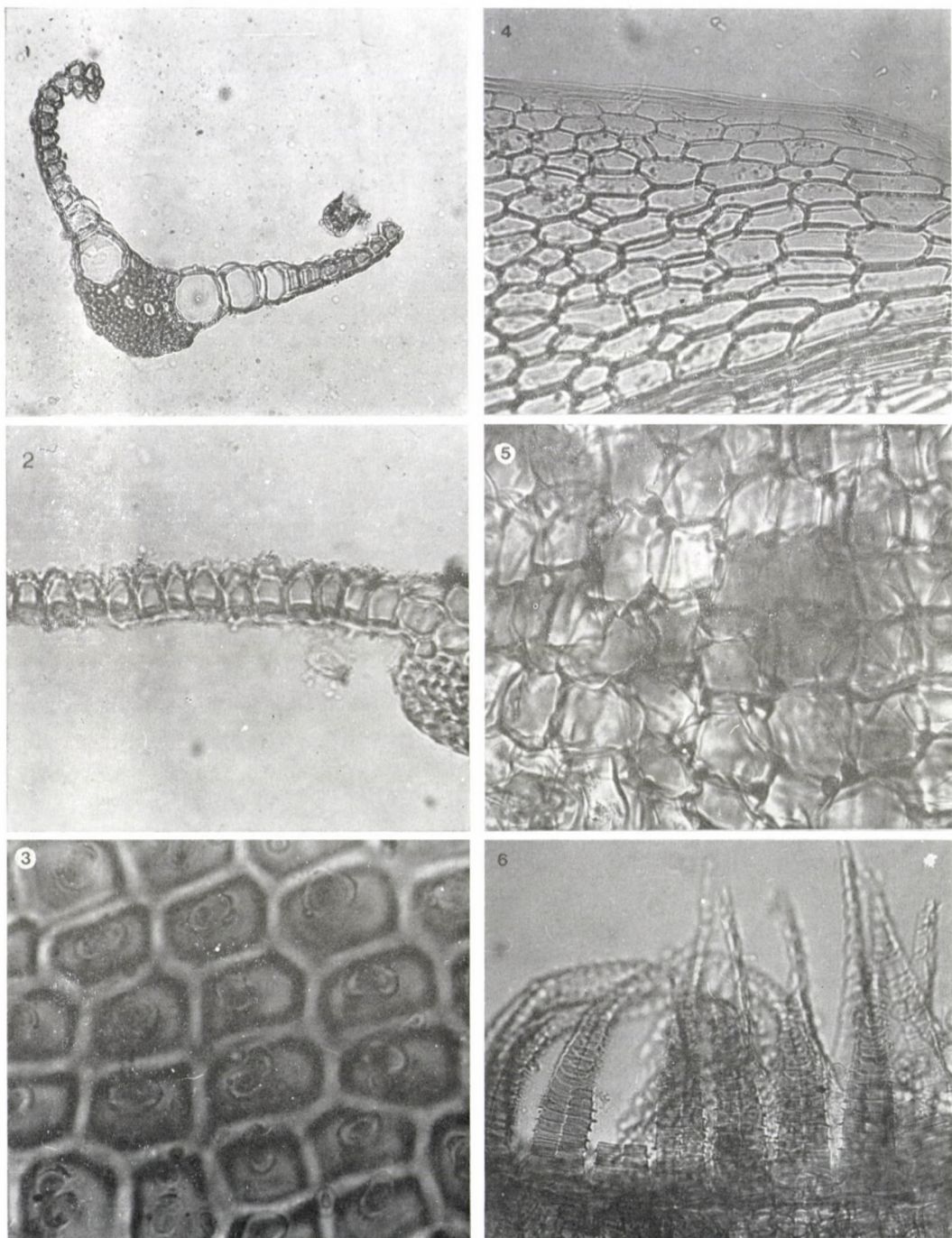
Plate II. *Calymperopsis vietnamensis* (1—3) and *Distichophyllum duongii* (4—6)

1. Cross section of leaf, ×23; 2. Ditto, ×50; 3. Leaf surface showing papillae, ×2000; 4. Leaf base cells, ×460; 5. Exothecial cells, ×750; 6. Peristome, ×23. All from holotypes
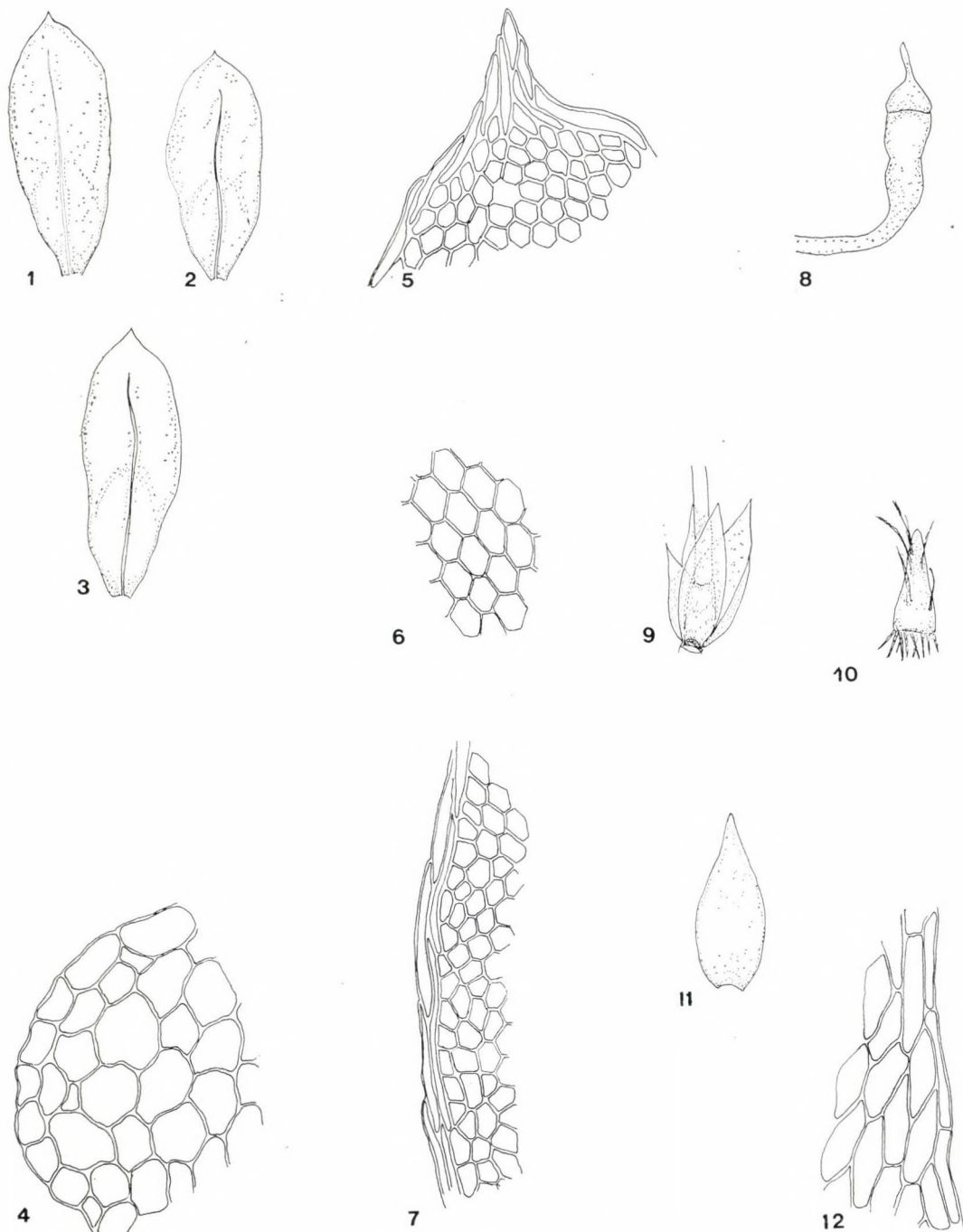
Plate III. *Distichophyllum duongii* (1—12)

1, 3. Lateral leaves, ×22; 2. Dorsal leaf, ×22; 4. Cross section of stem, ×540; 5. Apical part of leaf, ×540; 6. Cells from middle of leaf, ×270; 7. Midleaf margin, ×270; 8. Capsule, ×22; 9. Perichaetial leaves, ×22; 10. Calyptra, ×40; 11. Perichaetial leaf, ×30; 12. Per. leaf cells, ×270. All drawn from holotypes

Paraphyses paucae. Seta in sicco recurva, brunnea, glabra, 6—9 mm longa. Theca oblongai inclinata, collo distincto suffulta, cca 1.05×0.45 mm. Dentes peristomiales externi lanceolat, cca 0.3 mm longi, papillis in seriebus dense ordinatis striati. Peristomium interius pallidum, segmenta dentibus exterioribus aequilonga. Cellulae exotheciales hexagonales, parietibus delicatis trigonaliter incrassatis praeditae. Sporae globosae, 8—10 μm in diametro, papillosae.

Tamdao: Tropical lower montane evergreen forest, on rock, 1100 m (No. 68 149, Holotype in Hanoi, coll. Tr. NINH, 9. 12. 1968).

15.* **Distichophyllum montagneanum** (C. MÜLL.) V. A. BOSCH et LAC. Bryol. jav. 2: 23, 1861. — Sapa: on decaying wood, 1000 m, 7160. (Distr.: Philippines.)

16. **Distichophyllum mittenii** BOSCH et LAC., Bryol. java. 2: 25, 1861. — Tamdao: on tree, 1200 m, 68 204a. (Distr.: Tropical regions of E. Asia and Oceania.)

17. Calyptrochaeta pocsii sp. nov. (Fig. 3)

Medium-sized (about 0.8—1 cm), pale green, on decaying wood. Stems rounded or elliptical in cross section, 235—270 μm in diam. The medullary cells of stem are irregular hexagonal 20—40 μm in diam., with delicate, slight yellow walls. Central strand absent. The medullary cells are surrounded by a 2—4 layered epidermis with thick, sclerenchymatic, brownish-red cell walls. Leaf cells thin walled, rhomboid (±32.5×87.5 μm) at tip, becoming longer in the lower half of leaf (±37.5×132.5 μm). The border is composed of narrow, elongate cells (ordinarily 2 rows at the upper half and 3 rows at the leaf base) with porose walls.

Female bracts few in number, narrowly ovate, flat, nerveless, acuminate, denticulate. Archegonia 280—300 μm long. Male bracts widely ovate, entire, acuminate, antheridia 440—450 μm long.

Plantae statura medianae (cca 0.8—1 cm altae) pallide virides in trucis caducis crescentes. Caulidia in sectione transversali rotundata vel elliptica, 235—270 μm in diametro. Cellulae medullares irregulariter hexagonales, 20—40 μm in diametro, parietibus pallide flavis, delicatis suffultae. Vasus centralis absens. Cellulae medullares circumdatae cellulis epidermalibus sclerenchymaticis in 2—4 seriebus ordinatis, parietibus purpureo-brunneis suffultis. Cellulae phyllidii parietibus tenuibus, apice rhomboidales (±37.5×132.5 μm). Margo cellulis angustatis elongatisque, parietibus porosis suffultis (normaliter in seriebus 2 supra medium laminae, basi in seriebus 3 ordinatis) compositus.

Bracteae femininae paucae, anguste ovatae, planatae, enervatae acuminatae et denticulatae. Archegonia 280—300 μm longa. Bracteae masculae late ovatae, integrae, acuminatae, antheridia 440—480 μm longa.

Tamdao: Tropical lower montane evergreen rain forest, 1350 m (No. 68 202a, Holotype in Hanoi, on decaying wood, coll. Tr. NINH, 9. 12. 1968).

This species is similar to the Himalayan *C. spinosa* (NOG.) NINH in general appearance, but *C. pocsii* is smaller in size and has larger, decurrent leaves with shorter acumen, longer and larger cells. The teeth of leaf margin are composed by the ends of twin cells (see Plate IV:3).
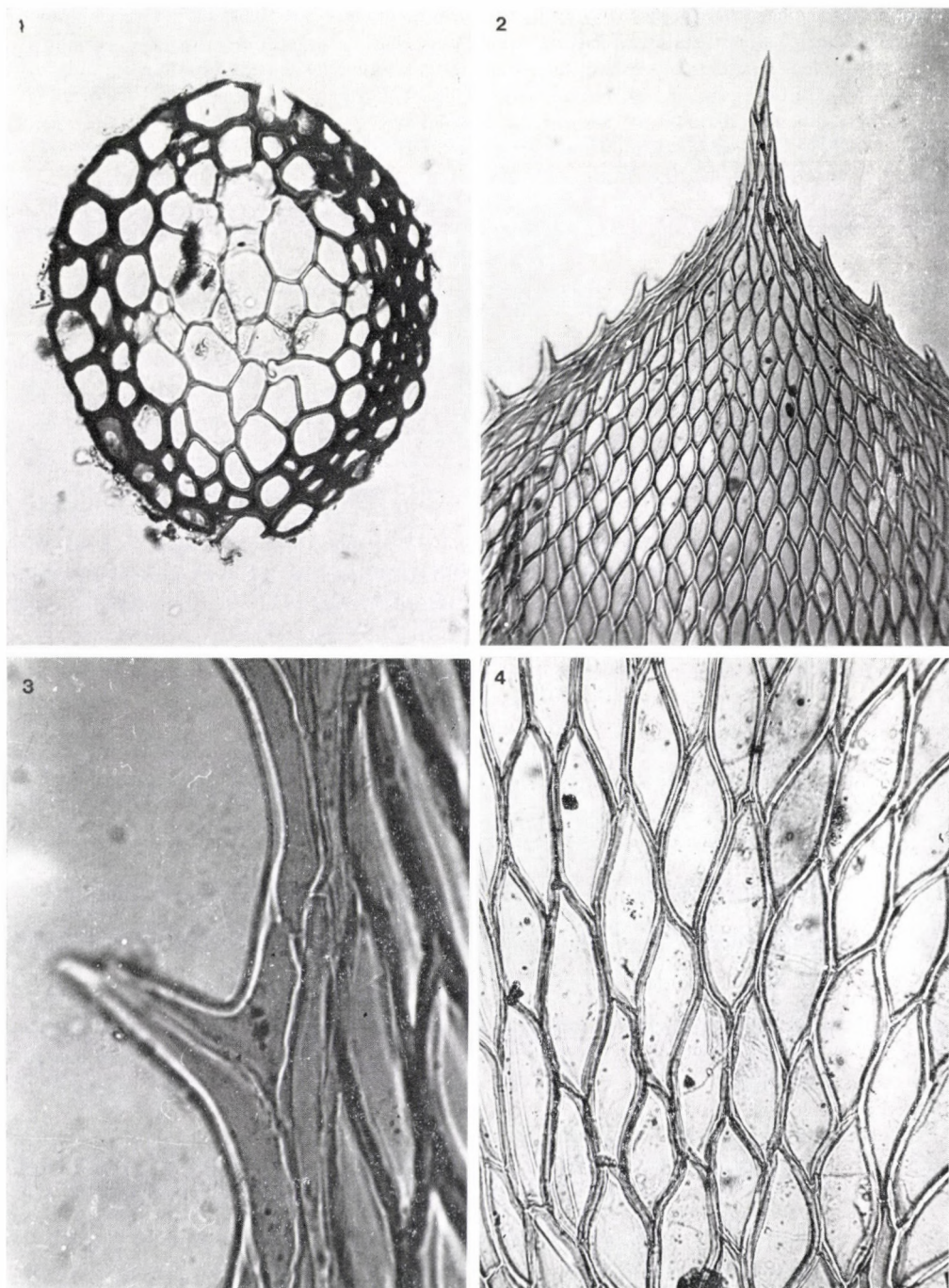
Plate IV. *Calyptrochaeta pocsii* (1—4)

1. Cross section of stem, ×240; 2. Leaf apex, ×90; 3. Marginal cells, ×600; 4. Middle lamina cells, ×240. All from holotypes

The related Himalayan species was described by NOGUCHI (1937) as *Eriopus spinosus. Eriopus* is an illegitimate name of the genus now properly called *Calyptrochaeta*, according to MARGADANT (1959) and to CROSBY (1976), therefore the following new combination is proposed:

Calyptrochaeta spinosa (NOG.) NINH **comb. nov.**

Basionym: *Eriopus spinosus* NOGUCHI, J. Sc. Hiroshima Univ. B(2) Bot. 3: 51, Fig. 6 (1937)

18. Lopidium javanicum HAMP., Linnaea 38: 672, 1874. — Tamdao: on bark of tree, 950 m) 67 160a. (Distr.: India, Ceylon, China, Malay Peninsula, Indonesia, New Guinea, New Caledonia.)

SEMATOPHYLLACEAE

19. Wijkia clastrobryoides (TIX.) NINH **comb. nov.**
Basionym.: *Acanthocladium clastobryoides* TIX., Rev. Bryol. et Lichenol. 35: 162. 1966. — Tamdao: on twigs of tree, 1000 m, 69 133 (Endemic to Vietnam).
CRUM (1971) proposed the new generic name of *Wijkia*, instead of the illegitimate *Acanthocladium*, but did not describe the above new combination.

20. Aptychella tenuiramea (MITT.) TIX. — Tamdao: on twigs of tree, 900—1200 m, 68 197, 68 205, 68 220, 68 221, 68 239, 68 244, 68 263a, 68 358b. (Distr.: Nepal, S. India, Laos, Vietnam, Indonesia.)

21. Chionostomum rostratum (MITT.) C. MÜLL., Linnaea 36: 21, 1869. — Tamdao: on tree trunks, 900—1100 m, 69 210, 69 211, 69 319. (Distr.: Himalaya, Assam, Thailand, Vietnam, Ceylon, Taiwan.)

22. Rhaphidostichum eberhardtii (P. v. D. et THÉR.) BROTH, Nat. Pfl. ed 2,11: 434, 1925. — Tamdao: on twigs of tree, 950—1100 m, 69 211, 69 262, 69 283, 69 389a. (Distr.: Endemic to Vietnam.)

23. Taxithelium instratum (BRID.) BROTH., Rev. Bryol 28: 110, 1901. — Tamdao: on bark of tree, 900 m, 69 225. (Distr.: Thailand, Vietnam, Malay Peninsula, Indonesia, Philippines.)

POLYTRICHACEAE

24.* Pogonatum proliferum (GRIFF.) MITT., J. Lin. Soc. Bot. Suppl. 1: 152, 1859. — Tamdao: 1200 m, 68 381. (Distr.: Himalaya, E. Asia, Malay Peninsula.)

25. Pogonatum submacrophyllum HERZ., Hedwigia 57: 236, 1916. — Sapa: on soil, 1750 m, 68 34. (Distr.: Indonesia.)

ACKNOWLEDGEMENTS

My most sincere thanks are due to Dr. T. PÓCS for helping the description of new species and for the careful reading of my manuscript and to Dr. A. BORHIDI for the Latin diagnoses. Some species were identified by Dr. A. NOGUCHI, Dr. T. KOPONEN, and Dr. W. R. BUCK. I am indebted to them.

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Acta Botanica Academiae Scientiarum Hungaricae, Tomus 27 (1—2), pp. 161—168 (1981)

NOGUCHIODENDRON, A NEW GENUS OF THE MOSS FAMILY *NECKERACEAE*

By

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(Received 1 February 1981)

During the examination of the Indochinese *Homaliodendron*, a new genus is segregated, described and discussed, based on the striking vegetative and reproductive characters of former *Homaliodendron sphaerocarpum* NOGUCHI. The new combination of *Noguchiodendron sphaerocarpum* (NOGUCHI) NINH et PÓCS is established.

Noguchiodendron Ninh et Pócs, genus novum

A genere Homaliodendron differt caulidiis cellulis centralibus vasiformiter elongatisque fasciculatis parietibus flavis suffultis: pinnis frondium in sicco valde revolutis, caulidio ipso apice recurvato; capsula subglobosa, cellulis exothecialibus quadratis vel isodiametrico sexangularibus, dentibus endostomialibus linearibus, applanatis; annulo thecae manifeste evoluto, sporis magnis 20—28 μm in diametro. Genus dedicavimus in honorem professoris A. NOGUCHI, *muscologi japonici eminentis.*

Moss typically dendroid in shape, with stolons creeping on substrate, with erect stem divided into a lower stipe and an upper, pinnately branched frond (Figs 1, 2). The stolons are attached to the substrate by rhizoids in tufts. The stipe has a central strand of elements with thin walls and narrow lumen in cross section, often yellow or brownish pigmented. It is distantly covered by appressed, at base decurrent, wide ovate, apiculate, pale, scalelike leaves. The frond is uni-, bi- or tripinnately branched. The branches and the upper part of the main stem itself, are more or less strongly recurved, when dry. The frond leaves are slightly complanate, ovate oblong to ovate, at base decurrent, widest at midleaf. The apex is obtuse, dentate, with a long central tooth. Leaf cells are slightly incrassate, smooth, rhomboid, at leaf tip subquadrate, gradually longer downwards with porose walls at the base; alar portion clathrate, consists of quadrate to oblong rectangular cells with thick, pale yellow walls. Costa single, rather stout, evanescent below apex. Branch leaves appressed to erect, margin serrulate-dentate at tip, crenulate-dentate towards the middle of leaf. Perichaetial leaves ovate to ovate-lanceolate, slightly concave, gradually to abruptly acuminate, tapering in a long, narrow
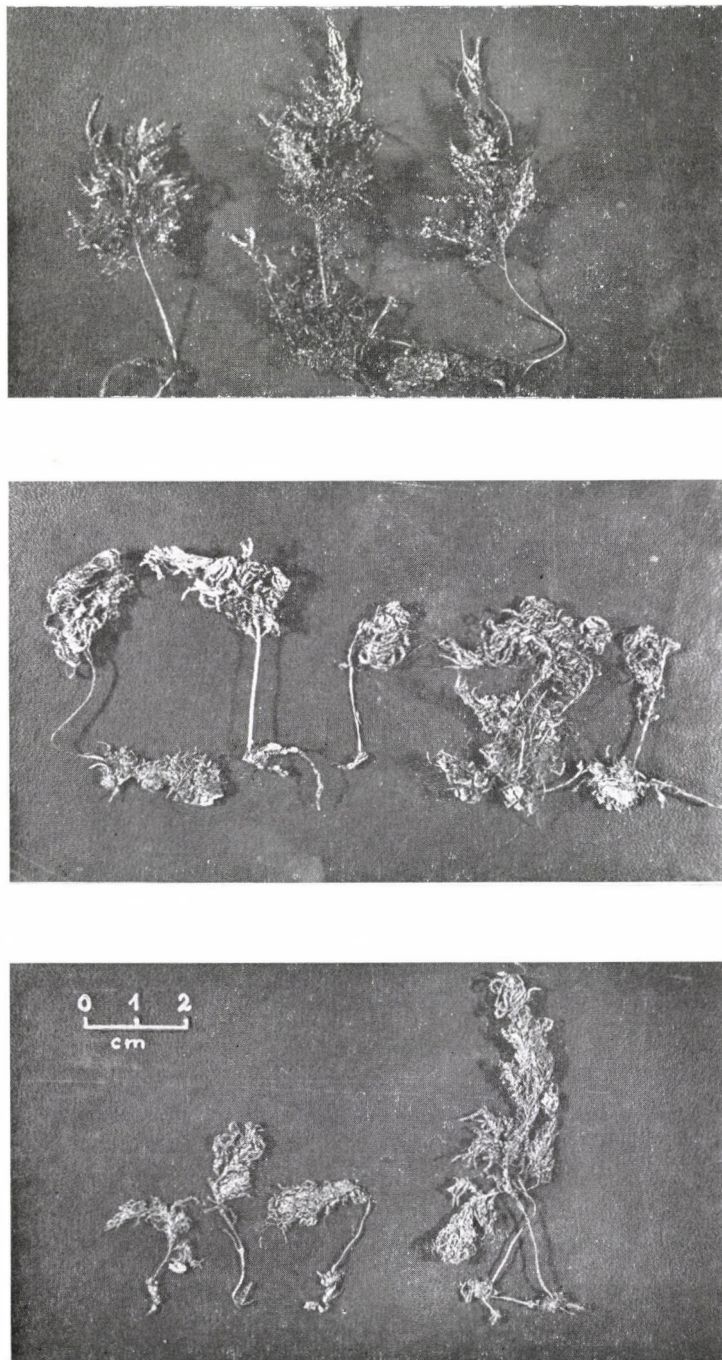
Fig. 1. Noguchiodendron sphaerocarpum (NOGUCHI) NINH et PÓCS. Himalayan populations in wet condition (upper picture, IWATSUKI 348) and in dry condition (median picture, IWATSUKI 348 and lower picture, Kabir Khan 1900)
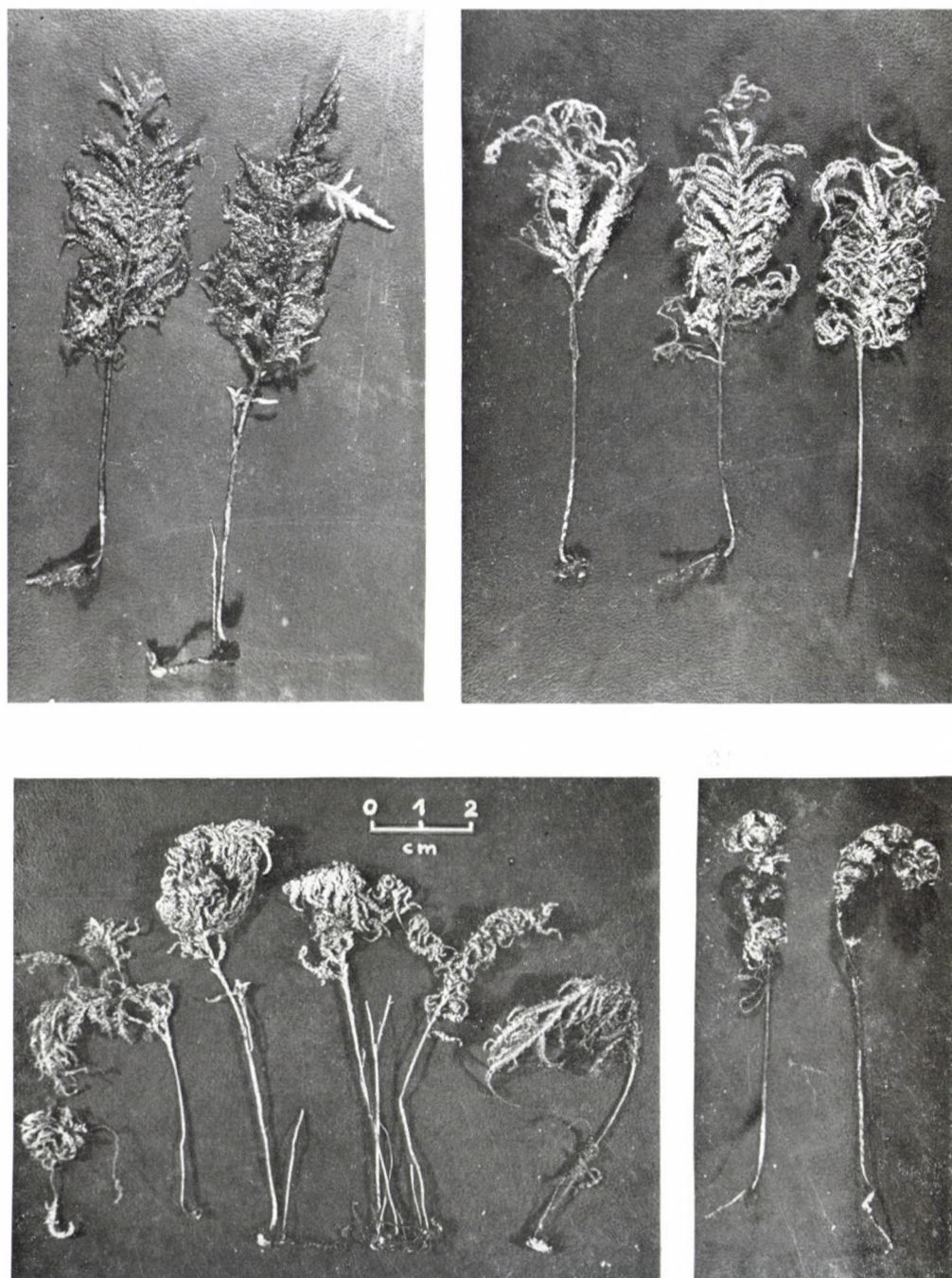
Fig. 2. Noguchiodendron sphaerocarpum (NOGUCHI) NINH et PÓCS. Thailand population, in wet condition (upper left picture), in semidry (upper right) and in dry condition (lower pictures). All from TOUW 10174

acumen. Seta short, smooth; capsule subglobose; exothecial cells parenchymatous, quadrate to hexagonal with thick walls, not arranged in lines; annulus well differentiated. Exostome teeth lanceolate, densely and coarsely papillose; endostome segments linear lanceolate, densely papillose, not keeled; basal membran rather low. Operculum conic, rostrate; calyptra cucullate, smooth. Spores globose, slightly papillose on surface.

Typus generis: **Noguchiodendron sphaerocarpum** (NOG.) NINH et PÓCS, **comb. nov.** (Figs 1—3)

Basionym: *Homaliodendron sphaerocarpum* NOGUCHI in Fl. E. Himalaya: 576 (Tokyo, 1966)
Syn.: *Porotrichum kumaonense* BROTH. in schaed. Illustrations: NOGUCHI l.c. Fig. 39, GANGULEE: Fl. E. India 5: 1422, Fig. 702 (Calcutta 1976)

Although NOGUCHI (l.c.) supplied a thorough diagnosis, we examined more specimens and discovered several new characters. Therefore we would like to accompany the above generic diagnosis and description by a much more detailed specific description, containing all these characters and their size variability, as listed below:

Dendroid, 3—10 cm tall, corticolous moss, with thin, long creeping stolons, adhaering by tuft forming rhizoids to the substrate. The erect part of the stem is uni-, bi- or tripinnately branched on a short or long stipe. The branching system together with the upper part of the stem, are more or less strongly recurved, when dry. The stem is elliptic in cross section, 0.5—0.6 × 0.7—0.8 mm in diam., composed of 8—12 layers of cortical cells hexagonal in shape, with strongly incrassated, yellowish brown walls, then of wider, thin walled medullary cells, finally a central strand formed by 10—20 cells of narrow lumen, with thin, yellowish or brownish walls (see Fig. 3). Stipe leaves 1.4—1.8 × 0.9—1.0 mm, broad ovate, appressed, decurrent at base, with a rounded, apiculate tip. The whole leaf is built up of linear cells, 37—65 × 5.5—7.5 μm in size. Cell walls incrassate, porose. Frond leaves applanate or erect, longitudinally plicate, when dry, slightly complanate, oblong-ovate to ovate, 1.9—2.5 mm long and 1.1—1.3 mm wide. Apex obtuse, serrulate, the central tooth longer and coarser, than the others. Leaf base decurrent, inflexed at one side by some of the lateral leaves. Leaf cells slightly incrassate, smooth, rhomboid, subquadrate, 15—20 × 7.5—11.3 μm at tip, gradually longer below: 20—40 × 7.3—10 μm at midleaf and 43—72 × 8—12.5 μm at base, with porose walls near the costa. Leaf margin at base consists of a group of rectangular cells, 17—25 × 7—13 μm in size. Costa single, stout, evanescent below apex. Branch leaves appressed to erect, longitudinally plicate, when dry, ovate, 0.78—0.83 mm long and 0.55—0.60 mm wide. Margin serrulato-dentate at tip, dentato-crenulate towards the middle of leaf. Perichaetium up to 2.5 mm long, outer leaves ovate, small, appressed, their apex spreading, elongate-lingulate, inner leaves from a wide, ovate base suddenly narrowed into a lanceolate to lingulate, erect, serrulate apex. Seta pendulous, 2—2.7 mm long, smooth, reddish brown; capsule subglobose, straight or slightly inclined, 1.5 mm long and 1.25 mm wide. Exothecial cells parenchymatous, quadrate to hexagonal, not arranged in lines, dark yellow in colour at the middle of urn, becoming smaller, reddish near the mouth; annulus well differentiated. Peristome double, Neckeraceae type: the exostomium consists of 16 linear-lanceolate teeth about 0.55 mm in length, densely, coarsely papillose, especially at their lower part. The endostome segments are linear, not keeled, papillose, with a rather low basal membrane and without cilia. Operculum conique, 1.1—1.3 mm long, with a short, inclined rostrum. Calyptra cucullate, smooth.

Spores globose, 20—28 μm in diameter, slightly papillose. Flagelliform branchlets of vegetative propagation present, small. Their leaflets are concave with entire margin, up to 0.27 mm in size.

Ecology: On tree trunks in humid, montane evergreen forests between 2150 and 3666 m.

Distribution: Himalayan—Indochinese species, occurring in Nepal, India (Kumaon and Sikkim) and in Northern Thailand (see Fig. 4). On the analogues of many other species, should be expected also from Burma, Southern China and from Northern Vietnam.

Specimens examined: India, Sikkim Himalaya, Darjeeling, Batasi, 2150 m (coll. Hara, Kanai, Murata, Togashi and Tuyama 200432, 200818, 200835, 6 May 1960, Isotypes of Homaliodendron sphaerocarpum Nog., NICH); Kumaon, Gori River, 3666 m (coll. Kabir Khan, 16. Aug. 1900, ex Hb. Levier in FH, identified by Brotherus as Porotrichum kumaonense n. sp.). East Nepal, between Basantapur (Bilbatay Bhanjiang) and Dor, 2350 m (coll. Iwatsuki 348, NICH, L); Thailand, Payap, granitic massive Doi (Mt.) Inthanon, 2250 m (coll. Touw 10174, HIRO, L, EGR, C), 2500—2570 m (coll. Touw 9734, L).

Taxonomic position

When *Homaliodendron sphaerocarpum* was described first by NOGUCHI (1966: 576), he noted: "The branches recurved, when dry and the globose capsules are characteristic of this species". There are, however, many more characters separating it from the other members of the genus *Homaliodendron*. Table 1 summarizes the main differences between the two genera:

Table 1

Main differences between the two genera

	Homaliodendron	*Noguchiodendron*
Stem	Without central strand	With central strand
Branches and upper part of stem	Straight, plane, when dry	Recurved, when dry
Capsule	Ovoid to cylindrical	Subglobose
Exothecial cells	Rectangular — subquadrate, arranged in lines	Quadrate to isodiametric hexagonal, not arranged in lines
Exostome teeth	Minuletly papillose	Coarsely papillose
Endostome segments	Lanceolate, keeled	Linear, not keeled
Annulus	Not or weekly developed	Well differentiated
Spore size	14—23 μm	20—28 μm

On the basis of the above differences we dare to segregate a new genus, *Noguchiodendron*, in the honour of the eminent Japanese muscologist, prof. A. NOGUCHI, who described our plant, as *Homaliodendron sphaerocarpum*.

Among the generic differences, we paid special attention to the well developed central strand in the stem (rare among other members of *Neckeraceae*, unknown in *Homaliodendron*), to the recurved branches (some analogues

10 µm

100 µm
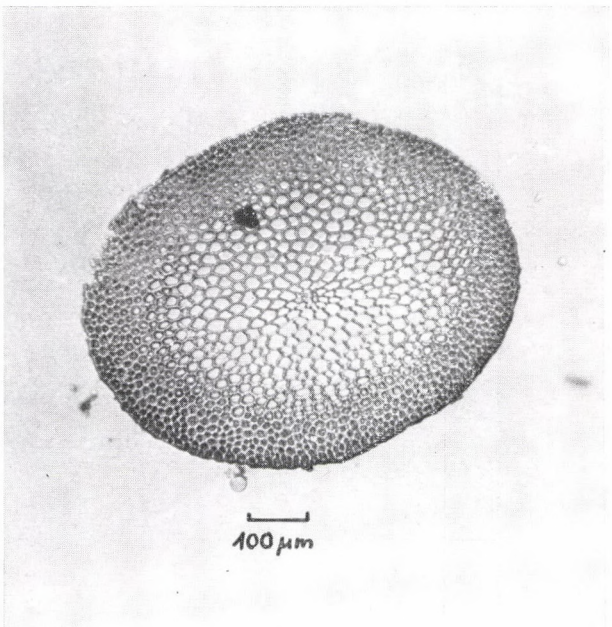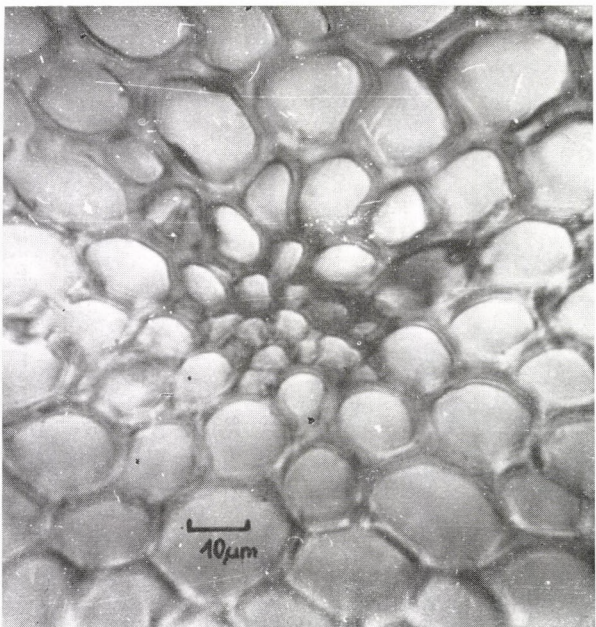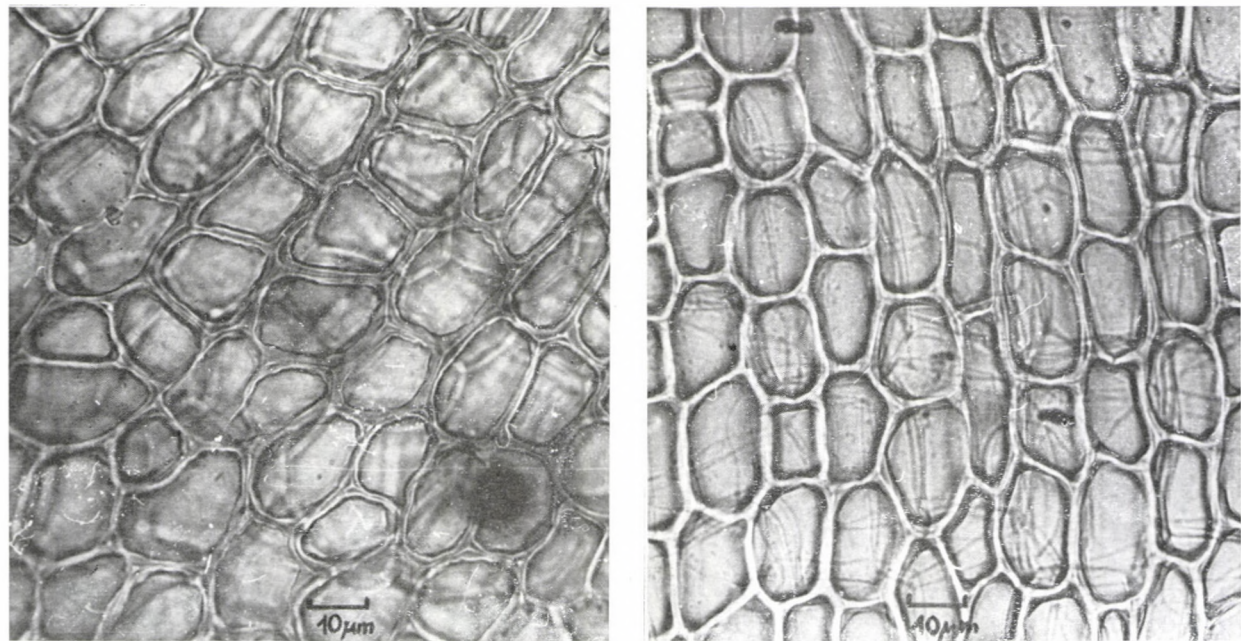
Fig. 3. Stem cross section of *Noguchiodendron sphaerocarpum* (upper left picture, KABIR KHAN 1900) and section of the central strand (upper right picture, TOUW 10174). — Exothecium cells of *Noguchiodendron sphaerocarpum* (lower left picture, TOUW 10174) and that of *Homaliodendron montagneanum* (lower right picture, Thailand, Payap, Doi Inthanon, 2570 m, TOUW 9735)
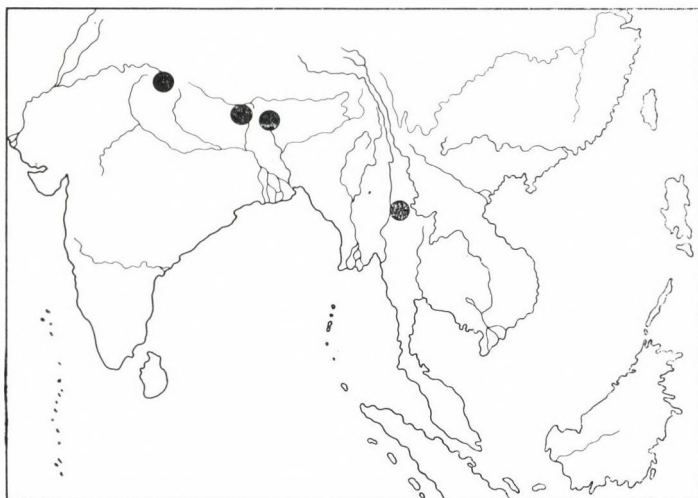
Fig. 4. The known distribution of *Noguchiodendron sphaerocarpum*, based on the herbarium and literature records (NOGUCHI 1966, TOUW 1968, TIXIER 1971)

with the hygroscopic movements in genera *Leptodon* and *Cryptoleptodon* within the same family), to the globoid theca and to the peristome morphology.

A matrix analysis on some *Homaliodendron* species (NINH mscr.) showed clearly the very isolated position of *H. sphaerocarpum* among other *Homaliodendron* species, confirming our opinion about its distinction at generic level.

The Himalayan populations of *Noguchiodendron sphaerocarpum*, including the type of *H. sphaerocarpum* described by NOGUCHI, are smaller in size, up to 7 cm (see Fig. 1), while the specimens from Thailand are larger, 10—13 cm tall (Fig. 2). Whether this difference merits the level of subspecies rank, or merely is a result of different environmental factors, is to be examined later.

ACKNOWLEDGEMENTS

The authors are indebted to prof. A. NOGUCHI for expression of his opinion, and to the directors and curators of the herbaria C, EGR, FH, HIRO, L and NICH, for lending their valuable materials for study, to Dr. A. BORHIDI for the translation of Latin diagnosis, finally to G. KIS for preparing the photographs.

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Acta Botanica Academiae Scientiarum Hungaricae, Tomus 27 (1–2), pp. 169–177 (1981)

STUDIES ON AFRICAN *CALYMPERACEAE*, III CONSPECTUS OF THE AFRICAN SPECIES OF *SYRRHOPODON* SCHWAEGR.

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(Received 1 January 1981)

The author proposes a new subdivision of the genus, in accordance with the ICBN. After studying the types and variation of the African species, he reduces the number of originally described, more than 90 taxa to 23, establishing 38 new synonyms. The most important are among them is the African occurrence of the American *Syrrhopodon gaudichaudii* and that of the now pantropical *Syrrhopodon gardneri*, known under different African species names before. The distribution of enumerated species is given, with many new localities.

Luckily there is a worldwide progress in the modern taxonomic revision of the family of *Calymperaceae*. The American *Calymperes* was monographed by REESE (1961), the genus *Calymperopsis* by TIXIER (1967), the Oceanic (most) species of *Mitthyridium* by NOVAK (1980), the American *Syrrhopodon* by REESE (1977, 1978), while the Indo-Malesian species by TIXIER (1978). EDWARDS (1980) revised the West African species of *Calymperes*, while the present author started to survey the African species of *Syrrhopodon* (ORBÁN 1977, 1978).

The present study intends to be the prodrome of a taxonomic monograph of the African *Syrrhopodon*, including the most important results in a shortened form. This short study will be followed by the detailed revision accompanied by full description of taxa, keys, illustrations and all information about the distribution of species, as the Part IV of the same series.

The author studied the type specimens of near all taxa described from Africa, and on this base tries to enumerate the African *Syrrhopodon* species with their whole synonymy and the list of studied specimens. During his study he used primarily the following morphologic characters: 1. Leaf shape; 2. Structure of leaf border; 3. The sheathing part of the leaf and the endohyalocysts; 4. The size and papillosity of chlorocysts; 5. Morphology of rhizoids; 6. The transversal section of leaf at different levels; 7. The morphology of midrib; 8. The general habit of the plants. The pores of hyalocysts used succesfully by EDWARDS (1980), as distinguishing character by the *Calymperes* species, are present by all members of the family, but by the *Syrrhopodon* species proved to be much less useful.

The subdivision of the genus, supplied by BROTHERUS (1924) does not fulfill the nomenclatural requirements of the present International Code of Botanical Nomenclature (1978), therefore the Author proposes a modified one, which includes his own observations and concept, concerning the African species.

During his revision the Author studied the type and many other specimens of the following herbaria: private herbarium of prof. M. BIZOT (now in PC), BM (incl. K), BP, BR, H, H-Br, JE, NY, PC and EGR. He expresses his gratitudes towards the owners, directors and curators of the above herbaria for their kind help.

The subdivision of the genus Syrrhopodon and its African species

Syrrhopodon SCHWAEGR. Spec. Musc. Suppl. 2 (1): 10, 1824

Subgenus: *Syrrhopodon*

Syn.: *Orthotheca* (BRID.) BROTH. Nat. Pfl. 1 (3). 370. 1901.

1. Sect. *Syrrhopodon*

Syn.: Sect. *Paracalymperes* FLEISCH. Musci Fl. Buitenzorg 1: 212. 1904. nom illeg. incl. lectotyp. gen.

African species: *S. gardneri* (HOOK.) SCHWAEGR.
S. aculeato-serratus BESCH.
S. brevivaginans DEMAR. et LEROY.
S. microblepharis P. VARD.
S. rodriguezii REN. et CARD.

2. Sect. **Crassimarginatae sect. nov.**

Type species: *Syrrhopodon asper* MITT. J. Linn. Soc. Bot. 22: 303. 1886.

Margo foliis incrassato e cellulae brevi vel longiusculi composito, in sectione transversalia cum stereidis.

African species: *Syrrhopodon asper* MITT.
S. mahensis BESCH.
S. mauritianus BESCH.

3. Sect. *Tricostatae* ORBÁN Acta Bot. Hung. 23: 174. 1978.

African species: *S. stuhlmanii* BROTH.
S. usambaricus BROTH. ex ORBÁN

Subgenus: *Heliconema* (MITT.) BROTH., Nat. Pfl. 1 (3): 371. 1901.

African species: *S. cryptocarpus* DOZ. et MOLK.

Subgenus: *Hyalolimbatae* **subg. nov.**

Type species: *Syrrhopodon prolifer* SCHWAEGR. Spec. Musc. Suppl. 2 (2): 99. 1827.
Syn.: *Eusyrrhopodon* (C. MÜLL.) BROTH. Nat. Pfl. 1 (3): 188. 1909. nom. illeg.

Margo foliis e basi ad apicem hyalino limbato.

1. Sect. *Hyalolimbatae*

Syn.: Sect. *Proliferi* BROTH. Nat. Pfl. 1 (3): 366, 1901.

2. Sect. *Hispidi* BROTH. Nat. Pfl. 1/3: 365, 1901.

African species: *S. hispido-costatus* REN. et CARD.
S. graminifolius REN. et CARD.

3. Sect. *Tristichi* BROTH. Nat. Pfl. 1 (3): 366, 1901.
African species: *S. lamprocarpus* MITT.
4. Sect. *Terebelleti* BROTH. Nat. Pfl. 1 (3): 360, 1901.
African species: *S. apertifolius* BESCH.
S. spiralis REN. et CARD.
5. Sect. *Crispati* BROTH. Nat. Pfl. 1 (3): 367, 1901.
African species: *S. isleanus* BESCH.
S. cuneifolius THÉR.
S. gaudichaudii MONT.
6. Sect. *Cavifolii* BROTH. Nat. Pfl. 1 (3): 367, 1901.
African species: *S. armatus* MITT.
S. insularum BIZ. et ONRAEDT
S. planifolius P. VARD.

Subgenus: *Leucophanella* (BESCH.) FLEISCH. Musci Fl. Buitenzorg 1: 195, 1904.

African species: *S. involutus* SCHWAEGR.

The African Syrrhopodon species

1. Syrrhopodon gardneri (HOOK.) SCHWAEGR. Sp. Musc. Suppl. 2 (1): 110, 1824.
Synonyma: *S. quintasii* BROTH., Bol. Soc. Broter. 8: 178, 1890. **syn. nov.**
S. welwitschii (DUB.) BESCH., Ann. Sc. Nat. Bot. 8. 1: 307, 1896. **syn. nov.**
S. hobsonii (GREV.) HOOK. et GREV. var. *spinulosus* HERZ., Beih. Bot. Centralbl. 26: 69, 1909. nom. nud.
S. ciliolatus HERZ., Bibliotheca Bot. 87: 166, 1916. non *S. ciliolatus* GEH. et HAMPE, Flora 64: 338, 1881.
S. maveganensis BESCH. var. *crispatus* THÉR., Receul. Publ. Soc. Havr. 1925: 133. ic. 1926. **syn. nov.**
S. brevifolius BROTH. et P. VARD., Rev. Bryol. 1: 91, 1928. **syn. nov.**
S. brevifolius BROTH. et P. VARD. var. *overlaetii* (THÉR. et NAV.) DIX. et THÉR., Rev. Bryol. Lich. 12: 69, 1942. **syn. nov.**
S. overlaetii THÉR. et NAV., Rev. Bryol. Lichénol. 4: 76,3, 1941. **syn. nov.**
S. gabonensis BROTH. et P. VARD., Rev. Bryol. Lichénol. 1.91. n. f. 3. 1928. **syn. nov.**

Typus: not studied.

Distribution: Africa: Madagascar, Tanzania, Zaire, Angola, Gabon, Sierra Leone; Central and South America; Asia: from India to the Philippines.

Representative specimens: Madagascar: Tsaratanana, 1924. BATHIÉ (sub. nom. *S. maveganensis* var. *crispatus* THÉR. holotype PC, isotype BM). — Tanzania: Uluguru, Lupanga, Pócs 6284/AC; Kanga Mts., Pócs 6139/AC (sub. nom. *S. quintasii* BROTH. EGR). — Zaire: riv. Lushiji, 1923, OVERLAET (holotype of *S. brevifolius* var. *overlaetii* (THÉR. et NAV.) DIX. et THÉR., PC). — Angola: Distr. Huilla, 1860, WELWITSCH (holotype of *S. welwitschii* (DUB.) BESCH. PC]. — Gabon: Latoursville, 1930. LE TESTU (sub. nom. *S. gabonensis* PC). Nzoumou, 1933, LE TESTU (sub. nom. *S. quintasii* BR); Divolo, 1927. LE TESTU 5644 (holotype of *S. gabonensis* BROTH. et P. VARD. PC). — Gombamoungo, 1927. LE TESTU (sub. nom. *S. gabonensis*, BR). — Sierra Leone: Bintumare, 1949.

JAEGER 1173 (sub. nom. *S. brevifolius* var. *ovarlaetii* H-BR). Sao. Thomé: leg. QUINTAS s. n. et l. (holotype of *S. quintasii* BROTH., H-BR). — South-America — Bolivia: Cerro de Santiago, HERZOG (type of *S. hobsonii* var. *spinulosus* sub. nom. *S. quintasii*, JE). — Indo-malaya: Sumatra, Pagaroeran, 1922, SCHÄFER, JE; Java, Tjibodas, 1900. FLEISCHER BP.

2. Syrrhopodon aculeato-serratus BESCH., Ann. Sci. Nat. Bot. Ser. 6 (9): 349, 1880.
Synonymon: *S. maveganensis* BESCH., Ann. Sci. Nat. Bot. Ser. 7 (22): 88, 1885. **syn. nov.**
Type: Réunion, LEPERVANCHE 19877 (PC?).
Distribution: Réunion, Madagascar, Tanzania.
Specimens examined: Madagascar: Donglava 1974, CREMERS, BR; Ambatofitorahama, 1970, ONRAEDT 704407 (sub. nom. *S. maveganensis* BR); Tamatao, 1979, TIXIER 12452 EGR (sub. nom. *S. gardneri*); Tananarive, Imerina, 1888, COMBOUÉ, PC. — Réunion: Plaine de Phicots, 1971, ONRAEDT 71R9177, BR; Plaine de Cafres, 1971, ONRAEDT (sub. nom. *S. maveganensis* BR).

3. Syrrhopodon brevivaginans DEMAR. et LEROY, Bull. Jard. Bot. Brux. 18: 224, 1947.
Type: Zaire, au Nord-Est de Yambao 1939, LOUIS 15363 BR.
Distribution: Tanzania, Zaire.
Specimens examined: Tanzania: Usambara, inter Magrotto et Muheza, 1906, BAUR, Bryoth. E. LEVIER 6792 H-BR. Uluguru, near Kinole, PÓCS—FADEN—CSONTOS—HARRIS 6264/N, EGR.

4. Syrrhopodon microblepharis P. VARD., Rev. Bryol. 8: 66.3. 1935.
Type: Nzoumou 1933, LE TESTU, PC.
Distribution: Cameroun, Gabon.
Specimens examined: Cameroun: N. Kolbison vers Yaondé, 1963, RAYNAL 9471, PC. — Gabon: Nzoumou, 1933, LE TESTU, PC, holotype.

5. Syrrhopodon rodriguezii REN. et CARD., Bull. Soc. R. Bot. Belg. 33 (2): 115, 1895.
S. rodriguezii var. *sublaevis* REN. et CARD. Bull. Soc. R. Bot. Belg. 33 (2): 116, 1895.
Type: Réunion: plaine des Gréguet et St. Philippe, RODRIGUEZ (RENAULD, Musci. masc. mad. exciss. no. 19)
Distribution: Réunion.
Specimens examined: Réunion, plaine des Gréguet et St. Philippe, RODRIGUEZ, PC, H-BR, isotype. — Bourbon, plaine de Gréguet (holotype cf. var. *sublaevis* REN. et Card. PC).

6. Syrrhopodon asper MITT., J. Linn. Soc. Bot. 7: 151, 1863.
Synonyma: *Syrrhopodon mildbraedii* BROTH. in MILDBR., Wiss. Ergebn. Deutsch. Zentr. Afr. Exp. 2,144. 12 f. 10. 1910. **syn. nov.**
S. mildbraedii BROTH. var. *parvifolius* P. VARD., Mém. Soc. Sc. Nat. Cherbourg 42: 89, 1936. **syn. nov.**
S. gomesii P. VARD., Svensk. Bot. Tidskr. p. 253, 1948. **syn. nov.**
S. gabonensis BROTH. et P. VARD. var. *aspericuspis* P. VARD., Rev. Bryol. 6: 141, 1934. **syn. nov.**
Type: Tanzania: Kilimanjaro, B. HANNINGTON., NY.
Distribution: Tanzania, Mozambique, Kenya, Zaire, Gabon.
Representative specimens: Tanzania: Kilimanjaro, HANNINGTON (holotype), NY; HEDBERG, BR; 1922 SOUL, BR. — Mozambique: Namuli Mts., 1947. GOMES et SOUSA 3491 (holotype of *S. gomesii* P. VARD. PC). — Kenya: Munha Hill, 1938, JOANA 7519 (sub. nom. herb. *S. kenyae* DIX. BM). — Zaire: Ruwenzori, 1908, MILDBRAED 2720 (holotype of *S. mildbraedii* BROTH., H-BR). — Gabon: Poubi, 1931, ANLIELNA 5114 (holotype of *S. mildbraedii* var. *parvifolius* P. VARD., PC). — Divolo, 1927, LE TESTU (holotype of *S. gabonensis* BROTH. et P. VARD., PC). — Mts. Iboundji, 1930, coll.: ? (holotype of *S. gabonensis* var. *aspericuspis* P. VARD., PC).

7. Syrrhopodon mahensis BESCH., Ann. Sc. Nat. Bot. Ser. 6.9.349, 1880.
Type: Seychelles, Mahé, G. DE L'ISLE.; PC.
Distribution: Seychelles (endemic).
Specimens examined: Seychelles — Mahé, Morna Pilot, 1908, GARDINER, H-BR; Cassada Mts. 1908, GARDINER, H-BR; Mahé, 1948, ERIKSSON, H-BR; Mahé 1875, G. DE L'ISLE, holotype PC, isotype BM; Silhouetta, 1908, GARDINER, H-BR.

8. Syrrhopodon mauritianus C. MÜLL. ex AONGSTR., Oefv. K. Vet. Ak. Foerk. 33 (4): 54, 1876.
Type: Mauritius, 1872, ANDERSON, PC.
Distribution: Réunion, Mauritius, Madagascar, Comores, Tanzania (cf. ORBÁN 1978).
Specimens examined: Réunion: leg. RODRIGUEZ. ex. Hb. J. CARDOT (H-BR). — Mauritius: leg. VOELTZKOW, 1904, H-BR, leg. ANDERSON 1872, holotype, PC; leg. JITADORROU, H-BR. — Madagascar: sect. d'Ivondro, poste de Soaramo, 1900 CROLL, H-BR. — Tanzania: Kilimanjaro, Bishop HANNINGTON, NY; Uluguru Mts., PÓCS 6105/AG, EGR, BP.

9. Syrrhopodon stuhlmannii BROTH., Bot. Jahrb. 24: 240, 1897.
Type: Tanzania: Uluguru, Bergwald, 1600 m, STUHLMANN 8809.
Distribution: Tanzania: Uluguru, Nguru (endemic).
Specimens examined and distribution map see in ORBÁN (1977).

10. Syrrhopodon usambaricus BROTH. ex ORBÁN, Acta Bot. Hung. 24: 113, 1978.
Type: Tanzania: Usambara, Lutindi, 1902. LIEBUSCH. H-BR.
Distribution: Tanzania.
Specimens examined see in ORBÁN (1978).

11. Syrrhopodon cryptocarpus DOZ. et MOLK., Natuurk. Verh. Holl. Maatsch. Wet. 10 (3): 147, 1854.
Synonymon: *S. lineaefolius* P. VARD. Rev. Bryol. 6.139. 1934.
Type: Surinam, von BEEK VOLLEHOVEN (not seen).
Distribution: Africa: Zaire, Gabon; South America: Trinidad, Brazilia, Peru, Venezuela, Columbia (REESE 1977).
Specimens examined: Zaire: Réserve Isolove, 1938, LOUIS 8319, BR; Yangabi, 1937, LOUIS 5958, 6006A, BR; Bengamisa, 1939, LOUIS 8247, BR. — Gabon: Moumba, 1926, LE TESTU 6638 (sub. nom. *S. lineaefolius* P. VARD., holotype, PC).

12. Syrrhopodon hispido-costatus REN. et CARD. in Ren. Rev. de Bot. 9: 394, 1891.
Synonymon: *S. subapertifolius* BROTH. nom. nud. in sched. H-BR.
Type: Madagascar: Diego Suares, CHENAGON 102, PC.
Distribution: Madagascar, Réunion.
Specimens examined: Madagascar: leg. POLLA et VAN DAM (sub. nom. *S. subarpertifolius* BROTH. H-BR; Detvinitarakae, 1901, NERWILTON, H-BR; Ambatofitozahama, Ambositra, 1970, ONRAEDT 70M408, PC, BR; Diego Suares, CHENAGON 102, holotype PC; Tamatave, Lakato, 1979, TIXIER 12478, Marvarastetria, 1979, TIXIER 12412. — Réunion: sud est du Piton, 1973, DE SLOOVER 17391, NAM. — Raviue de Tremblet, forêt domaniale de Saint Philippe, 1971, ONRAEDT 71R9353, BR.

13. Syrrhopodon graminifolius REN. et CARD. in Ren. Rev. de Bot. 9: 394, 1891.
Type: Beango (St^{e} Marie de Madagascar), leg. ARBOGAST 240, PC.
Distribution: Madagascar.
Specimens examined: Madagascar: Tamatave, 1897, PERROT, H-BR; Beango, St. Marie de Madagascar, ARBOGART 240, holotype, PC.

14. Syrrhopodon lamprocarpus MITT. J., Linn. Soc. Bot. 7: 151, 1863.
Synonymon: *S. afro-tristichus* C. MÜLL. nom. nud.
Type: Fernando-Poo, leg. MANN.
Distribution: Kameroun, Fernando Poo, S. Tomé, Gabon, Rwanda.

Specimens examined: Kameroun: prope Bomanam, 1892, DUSÉN (K). — Gabon: entre Piri et Moncighé, 1926, LE TESTU (ex Hb. BIZOT). — Rwanda: forêt de Nyungwe Km 22 de la piste Pindura-Bweyeye, DE SLOOVER 18 889, 18 902, 18 927, EGR; Butre-Cyangugu, DE SLOOVER 18 932; Ruwankuba, DE SLOOVER 12 490, 12 495; Gisakura, DE SLOOVER 19 053; Kamirazou, DE SLOOVER 18 976, EGR.

15. Syrrhopodon apertifolius BESCH., Ann. Sc. Nat. Bot. ser. 6.9: 350: 1880.

Synonyma: *S. glaucophyllus* REN. et CARD., Bull. Soc. R. Bot. Belg. 29 (1): 174, 1890. **syn. nov.**

S. glaucophyllus REN et CARD. var. *rufus* REN. et CARD., Bull. Soc. R. Bot. Belg. 33 (2): 116, 1895. **syn. nov.**

S. littoralis C. MÜLL., Gen. Musc. Fr. 369, 1900. nom. nud.

S. boulayanum BROTH. nom. nud. in sched. H-BR.

Type: Maurice — Savanna, 1847—52 BOIVIN, PC.

Distribution: Mauritius, Bourbon, Comores, Tanzania.

Specimens examined: Mauritius: Savanna, BOIVIN, isotype, H-BR; leg. RODRIGUEZ (sub. nom. *S. glaucophyllus*) H-BR, BR; Laucte Petrin, ONRAEDT 71 Ma 42, BR; Curepipe 1891, RODRIGUEZ, PC. — Réunion: Plaine de Cafres, ONRAEDT 69R52B (sub. nom. *S. glaucophyllus* var. *rufus*, BR); Bourbon, leg. RODRIGUEZ (sub. nom. *S. boulayanum* REN. et CARD. nom. prov. in schaed. H-BR). — Comores: Nossi Bé, 1879, HILDEBRAND, H-BR. — Madagascar: Inter Amalamazoatra et Andevorante, COMBUÉ (sub. nom. *S. glaucophyllus* REN. et CARD., isotype, H-BR); St. Marie de Madag., 1893, DARBOULE (sub. nom. *S. glaucophyllus* REN. et CARD., H-BR); Ost-Madag., 1904, VOELTZKOW (sub. nom. *S. glaucophyllus*, H-BR); Manamara, 1920, DECARY (sub. nom. *S. glaucophyllus*, H-BR); Mahovara, CREMERS 2238 (sub. nom. *S. glaucophyllus* var. *rufus*, H-BR); Andworate, 1895, PERROTT, PC. — Tanzania: Kilimanjaro, HANNINGTON, det. S. ORBÁN, NY.

16. Syrrhopodon spiralis REN. et CARD. in Ren. Rev. de Bot. 9: 393, 1891.

Synonyma: *S. integrifolius* BARTR., Medd. Göteborgs. Bot. Trädgard. 18: 27, 1950. **syn. nov.**

S. brevicaulis BARTR., Medd. Göteborgs. Bot. Trädgard. 18: 271, 1950. **syn. nov.**

S. spathulifolium P. VARD., Rev. Bryol. 19.174.4. 1950.

S. subspiralis CARD. in GRAND., Hist. Madag. 39: 177, 1917.

S. chlorosus BROTH. nom. prov. in schaed. H-BR.

Type: Madagascar: Ambositra, 1890, SOULA.

Distribution: Seychelles, Madagascar, Tanzania.

Specimens examined: Seychelles: Mahé, 1948, ERIKSSON (sub. nom. *S. integrifolius* BARTR., Usambara, 1903, JOSHI (sub. nom. *S. chlorosus* BROTH. nom. nud. in sched. H-BR); Uluguru, 1969, PÓCS and GIBBON 6055/H, EGR; Ukaguru, 1972, PÓCS and MABBERLEY 6737/P, EGR.

17. Syrrhopodon isleanus BESCH., Compt. Rend. Ac. Sc. Paris, 81: 722, 1875.

Synonymon: *S. islei* BESCH. ex KINDB., Enum. Bryin. Exot. 76. 1888. nom. illeg. incl. spec. prior.

Type: Ile St. Paul, G. DE l'ISLE 1874—75., BM.

Distribution: Ile St. Paul.

Specimen examined: Ile St. Paul, G. DE L'ISLE, 1874—75. holotype BM, Isotype PC.

18. Syrrhopodon cuneifolius THÉR., Receuil. Publ. Soc. Havraise. Etud. Div. 1: 86. i.e. 1924.

Type: Massif d'Ankaizinana, DECARY 1923., PC.

Distribution: Madagascar.

Specimen examined: Madagascar: massif d'Ankaizinana 1923, DECARY, holotype PC, isotype H-BR.

19. Syrrhopodon gaudichaudii MONT., Ann. Sci. Nat. Bot. ser. 2. 2: 376, 1834.

Synonyma: *S. lepervanchei* BESCH., Ann. Sc. Nat. Bot. ser. 6. 9: 350, 1880. **syn. nov.**
S. lindae P. VARD., Rev. Bryol. Lich. 22: 12.5. 1953. **syn. nov.**
S. subleucophanoides P. VARD., Svensk. Bot. Tidsk. 42: 251, 1948. **syn. nov.**
S. seignaci BESCH., Ann. Sci. Nat. Bot. Ser. 6. 9: 351, 1880. **syn. nov.**
S. oxyphyllus P. VARD., Rev. Bryol. 6: 137.4. 1934. **syn. nov.**
S. pulvinaris PAR., Mem. Soc. Bot. France. 14: 15, 1908. **syn. nov.**
S. pobeguinii PAR. et BROTH., Rev. Bryol. 3: 119, 1904. **syn. nov.**
S. acrodontus DEMAR. et LEROY, Expl. Parc. Nat. Albert, Miss. Lebrun 6 (6): 11,8—11. 1944. **syn. nov.**
S. uncinifolius C. MÜLL., Hedwigia 38: 96, 1899. **syn. nov.**
S. uncinifolius C. MÜLL. var. *anomalus* C. MÜLL., Hedwigia 38: 96, 1899. **syn. nov.**
S. cirrifolius SCHIMP. in JAEG., Ber. S. Gall. Naturw. Ges. 1871—72, 478, 1873. **syn. nov.**
S. erectifolius C. MÜLL. in Hedw. 1899. p. 96. **syn. nov.**
S. obliquirostris C. MÜLL. Syn. 1: 543, 1849. **syn. nov.**
S. grainvillei P. VARD. et THÉR., Receul. Publ. Soc. Havr. 138, 1932. **syn. nov.**
S. atlanticus DIX. in CHRIST., Res. Norv. Sc. Exp. Tristan da Cunha 48: 22, 1960. **syn. nov.**
S. puccinigerus BROTH. nom. prov. in schaed. H-BR.

Type: Brazil, leg. GAUDICHAUD, isotype, NY.

Distribution: East African islands, the whole tropical and South Africa (except dry areas): Tristan da Cunha; America: from Florida to Venezuela.

Representative specimens: Réunion: leg. LEPERVANCHE (sub. nom. *S. lepervanchei* isotype, H-BR). — Comores: Nossi Bé, leg. SEIGNAC (sub. nom. *S. seignaci* BESCH. holotype, PC). — Madagascar: Kiangara, 1831, GRAINVILLE (sub. nom. *S. grainvillei* P. CARD. holotype, PC); Ambositra, 1970, ONRAEDT (sub. nom. *S. glaucophyllus*); Ambositra 1970, ONRAEDT (sub. nom. *S. lepervanchei*, PC); Ankeramadinika, 1891, COMBOUÉ (sub. nom. *S. lepervanchei*, PC). — Tanzania: Nguru, Pócs and SCHIEBEN 6438/AF sub. nom. *S. lepervanchei* EGR, BP, Usambara, 1893, HOLST (sub. nom. *S. lepervanchei*, H-BR); Uluguru, Pócs, SHARMA and MWANJABE 6546/H, EGR. — Mozambique: Namuli Mts., GOMES et SOUSA 3491 (holotype of *S. subleucophanoides* P. VARD., PC). — Zaire: Lacs Eduard et Kivu, 1937, LEBRUN (holotype of *S. acrodontus* DEMAR. et LEROY., BR); Kafukumba, 1922, OVERLAET (holotype of *S. linealis* DIX. et THÉR., BR). — Malawi: Zomba Mts., 1955, E. W. JONES 741, PC; Mlanje Mts., 1946, BRASS 16449, PC (sub. nom. *S. lindae* P. VARD.). — Gabon: Uzonouá, 1933, LE TESTU (holotype of *S. oxyphyllus* P. VARD., PC). — Guinea: Mamou, 1907, POBEGUIN (holotype of *S. pulvinaris* PAR. et BROTH., PC); Konakry, 1904, POBEGUIN (sub. nom. *S. pobeguinii* PAR. et BROTH., holotype, PC). — Tristan da Cunha: Sandy Point, CHRISTOPHERSEN et MEYLAND 1184 (isotype of *S. atlanticus* DIX., PC); Nichtingale, 1938, CHRISTOPHERSEN 2261 (sub. nom. *S. atlanticus* DIX., co-type, PC). — Brazilia: leg. GAUDICHAUD, isotype, NY; Seabra, 1971, IRWIN, HARLEY, SMITH 31127, NY, Alto do Paraiso, 1971, IRWIN, HARLEY, SMITH 33196, NY, S. Paolo, 1879, PUIGGARI 277, ex hb. BROTHERUS, NY. — Argentina: Tucuman, 1960, STEERE 60-296, NY. — Venezuela: Sierra Nevada de Mérida, GRIFFIN 1386, NY. — Columbia: Andes Bogotenses, WEIR 152, NY.

20. Syrrhopodon armatus MITT., J. Linn. Soc. Bot. 7: 151, 1863.

Synonyma: *S. afro-ciliatus* C. MÜLL. ex DUS., K. Svensk. Vet. Ak. Handl. 28 (2): 15 a—d. 17, 1895. **syn. nov.**
S. rubrotomentosus CARD., Rev. Bryol. 35: 65, 1908.
S. rubrotomentosus CARD. var. *sublaevis* P. VARD., Ann. Crypt. Exot. 5158, 1932.

S. rubrotomentosus var. *subciliatus* P. VARD., Mém. Soc. Sc. Nat. Cherbourg 42286, 1936.
S. paucifimbriatus C. MÜLL. ex DUS., K. Svensk. Vet. Ak. Handl. 2812. 16 a–e 2f. 16. 1895. **syn nov.**
S. tenellifolius (DUS.) BESCH. in Par. Ind. Bryol. ed. 2, 4: 350, 1905. (sub. *Calymperes* 1896) **syn nov.**

Type: Cameroun: Bangroo River and banks of the Nunn, leg. MANN.

Distribution: Zaire, Gabon, Cameroun, Nigéria.

Representative specimens: Zaire: Equateur, 1904, TYNAERT, H-BR; Leboulou, 1929, BABET 138 (holotype of *S. rubrotomentosus* var. *sublaevis*, PC); Yambao, LOUIS 15364; Yangabi, 1937, LOUIS 6543, BR. — Gabon: Pays Batéké, Est de Franceville, 1930, BRUCHARD, PC; Parte Trambo et Ghedila, 1925, LE TESTU, BR; Eala, 1923, VAN OYE, BR; Mele, 1922, PHILIPPE, BR; Boungou et Ounzenzi, 1925, LE TESTU (sub. nom. *S. afrociliatus*, EGR). — Cameroun: Bangroo River, MANN, isotype, BR; Ekunde, 1892, DUSÉN 828 (sub. nom. *S. paucifimbriatus* C. MÜLL., isotype, BR).

21. Syrrhopodon insularum BIZ. et ONRAEDT, Rev. Bryol. 42: 848, 1976.

Synonymon: *S. divergens* BROTH. nom. herb. H-BR.

Type: Réunion: Réserve forestière de la Mare Longoue de St. Philippe, 1969, ONRAEDT 69R963.

Distribution: Réunion, Seychelles, Madagascar, Tanzania (see the map and the list of specimens in ORBÁN 1977.

22. Syrrhopodon planifolius P. VARD., Rev. Bryol. Lich. 6: 138. 5. 1934.

Synonyma: *S. decipiens* P. VARD., Bull. Mus. Hist. Nat. Paris ser. 2. 13: 209, 2. 1941. **syn. nov.**
S. chevalieri P. VARD., Rev. Bryol. 18: 109, 3. 1949. **syn. nov.**
S. nigerianum BIZ. nom. prov. in schaed. Hb. BIZOT (PC).

Type: Gabon: Rochers de Bindélé près Bissok., PC.

Distribution: Gabon, Upper Volta, Guinea, Nigéria.

Specimens examined: Gabon: Rochers de Bindélé près Bissok, 1939, LE TESTU 5007, holotype, PC. — Upper-Volta: leg. CHEVALIER (holotype of *S. chevalieri* P. VARD., PC). — Guinea: Kindia, 1937, FELIX (isotype of *S. decipiens* P. VARD., BR). — Nigéria: Sanga River Forest Reserve, Jema'a, 1958, JONES 1012 (sub. nom. *S. nigerianum* BIZ., EGR).

23. Syrrhopodon involutus SCHWAEGR.

Synonyma: see TIXIER (1978).

Type: not seen.

Distribution: Réunion, Seychelles, Nosy Bé, Madagascar, Zaire.

African specimens examined: Réunion, Bourbon, RODRIGUEZ (sub. nom. *S. microbolax* C. MÜLL., H-BR). — Seychelles: Mahé, Morna Pilot, 1908, GARDINER, H-BR (sub. nom. *S. microbolax*). — Mauritis: Malenge, Deux Manelles, 1974, COOK 4380, K (sub. nom. *S. revolutus*). — Madagascar: St. Maria, 1892, DARBOULD, H-BR (sub. nom. *S. microbolax*). — Zaire: Yangabi, 1937, LOUIS, 7064 (sub. nom. *S. revolutus*, BR).

Status uncertain

Without seeing the type specimens, it was impossible to establish the relationship of the following species:

Syrrhopodon congolensis BESCH. J. Bot. (Morot) 8: 43. f. 12—13. 1894.
S. phragmidiaceus C. MÜLL. Flora 69: 511. 1886.
S. semi-circularis C. MÜLL. Verh. Bot. Vereins Prov. Brandenburg 31: 67. 1889.

On the base of the very short diagnosis of *S. phragmidiaceüs* and *S. semi-circularis*, it seems to be impossible to decide, whether they are independent species, or conspecific with others. *Syrrhopodon congolensis* BESCH., according to its description, is probably a later synonym of *S. lamprocarpus* MITT. 1863.

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Acta Botanica Academiae Scientiarum Hungaricae, Tomus 27 (1–2), pp. 179–187 (1981)

THE PROLINE CONTENT AND FERTILITY OF THE POLLEN INBRED MAIZE LINES

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(Received 12 March 1980)

The free amino acid composition and quantity of the pollen of ten inbred maize lines were studied. The pollen was collected from 40 tassels by lines, in the course of 12 hours, at the time of the highest dissemination.

1. The free proline content of pollens was found to be high and its concentration was correlated with the degree of fertilizing capacity. We can infer that the pollen of those inbred lines have more vitality and fertility where the proline content is between 1.5 and 2.5% of the dry-matter.

The highest level of pollen quantity and the water-binding capacity (vitality) is to be found in the pollen of the eight lines belonging to the proline interval of the inbred lines. Presumably, the 1.0% proline concentration of the pollens is the level under which the lines are of weak vitality and reduced fertility. Two of the lines examined can be categorized in this group; their proline content is 0.7 and 0.9%. The pollen production and the water-binding capacity of the pollens in these two lines are also at the lowest level.

2. No characteristic deviation could be detected connected with fertility in the total amino acid content without proline, of the pollen in the 10 kinds of lines. In the 8 kinds of pollens with high proline content, that is, in the fertile pollens, the concentration of proline was in itself much higher than the concentration of the other free amino acids taken together. At the time, the free proline content of the two kinds of pollen with weak fertility showed a concentration significantly lower than the total amino acid content.

3. No characteristic difference could be found in the qualitative composition and soluble total protein content in the amino acids of pollens having high and low proline concentrations.

4. It follows from the results that the determination of the proline quantity of pollen in inbred maize lines is a suitable index of pollen vitality and fertility. The part played by proline in pollen and its advantages are discussed in this study.

5. The practical implications of our experiment is that if a very high proline content' is applied in hybridization a line such seed vigourousness can be promoted that it will be manifest not only in germination and by a stronger vitality of the growing plants but also in the greater quantities and better quality of the crop to be produced by the successor plants.

6. Another advantage in practice is that if we select for "minus proline" by individuals, in self-fertilization with pollens of weak fertility emerging with "very low proline" level, we can produce a male sterile line during a few breeding periods.

Introduction

BRITIKOV and LINSKENS (1970) established that of the free amino acids the presence of proline implies a clear positive correlation with the fertilizing ability of the pollen grains. STANLEY and LINSKENS (1974) as well as BRITIKOV (1975) pointed out by means of L-proline-C^{14} and L-proline-N^{15} isotopes that proline migrates from the leaves into the anthers, then

after getting into the pollens, it spreads evenly in the cytoplasm. According to the authors, the concentration of free proline is closely related to the developmental course of the induction of flowering and with the fertility of pollens. RAI and STOSKOPF (1974) proved in wheat that the well-fertilizing pollens in all cases proved to be so on account of their high proline concentration.

DURANTON and MAILLE (1962) attribute an important role of high proline content of the pollen, with the energetic transformation and the transferring of the amino-groups at the germination time of the pollen tube. LINSKENS and SCHRAUWEN (1969, 1970) pointed out the function of free proline also in the germinating of the pollen tube and in its correlation with the style. KWANGSI (1977), as well as YAMADA and KONO (1977) stated in inbred rice lines and hybrids that in the fertile anthers and pollens the quantity of free proline is essentially higher then that in pollens of weak fertility or in sterile pollens.

TUPY (1964) and ALARKON et al. (1977) found that (among the amino acids of pollens) proline plays an essential part as an efficient activator of the Krebs cycle, a significant nitrogen source and that it is also able to normalize the water household. According to these authors, the proline content of pollens is a good index of the degree of their fertility. This fact has been proved by TSUVASHINA and MELNIKOV (1964) as well as by PFAHLER and LINSKENS (1970, 1973) on maize varieties and hybrids.

In our experiment on 10 kinds of inbred maize lines we have studied the quantity of pollen produced in 12 hours, at the time of highest pollination, also what quantity of water and dry matter is contained in the pollens by lines. Considering that the fertility of maize pollen shows a close correlation with their proline content, the proline content of pollens will be analysed and evaluated separately. The basis of our analysis is the proline concentration of the two kinds of maize line well known from practice which are low in vitality and fertility, and the data obtained from the specialized literature (PFAHLER and LINSKENS 1970, 1973; STANLEY and LINSKENS 1974, BRITIKOV 1975).

The total amino acid content — building up proteins — and the soluble total protein content in maize lines, as well as the quantitative composition of amino acids will be examined. The correlation between these results and proline concentration and the extend of fertility will be studied.

Material and method

The inbred maize lines were produced in the Ságvári Depot of the Cereal Research Institut e, on a good-quality humus-clay soil of open country in uniformly optimal water and nutrient supply conditions. The pollen samples were collected on the day of the highest pollination, in favourable, sunny weather, from the tassel of 40 plants by lines, in 12 hours.

The international signs of the maize lines are given in the tables. Among these lines there are such that according to experiences gained in practice produce a relatively small quantity of pollen, and the vitality or fertility of which is essentially lower than the average (line 1 = SzV 13; line 2 = GK 72). We must note however that in maize even such lines of reduced pollen production and weak fertility usually reach a satisfactory level of pollination by means of their living pollen representing still a significant mass.

After gathering the plants, the fresh matter of the pollen of the 40 plants was measured together by lines (this is the quantity of the pollen production). Then, dried to weight constancy, it was weighed. To detect the free amino acids, 200 mg of dried pollen was measured and homogenized with 1.0 g quartzsand and 20 ml 40%-ethanol, then washed into the centrifugal tubes. After centrifuging for 20 minutes at 6000 cpm we obtained entirely clean amino acid abstracts.

The protein-building total amino acids were measured according to ROSEN (1957), on a spectrophotometer. The proline quantities were measured on the basis of CHINARD's method (1952), with slight modifications by BATES et al. (1973) and SINGH et al. (1973). The qualitative and semi-quantitative determination of amino acids was carried out by means of

the universal plant standard consisting of 17 kinds of amino acids (PÁLFI 1971, PÁLFI et al. 1973).

The soluble total protein quantity was analysed on the basis of the nephelometrical method of COLOWICK and KAPLAN (1957). Proteins were extracted by means of tris-puffer set at a 7.5 pH value. All three kinds of precipitating agens were applied, in repetitions.

The average results of the analysis repetitions are presented. When the deviation of the repetition of some measurement from the average results surpassed $\pm 5\%$, the whole part-analysis was repeated. The results obtained by the methods applied by us were already checked by the results obtained by means of the Biocal BC 200-type automatic amino acid analysator (PÁLFI et al. 1974, 1975).

Experimental results and evaluation

Under optimal external conditions, mainly good water-supply, free proline can be detected only at very low concentration from the leaves of flowery plants. It constitutes 0.02—0.04% of the dry matter at the most (PÁLFI 1968a). In the leaves of culture herbaceous plants free proline can however accumulate to an extremely great extent under the effect of a strong drought, and it can reach even 2—5% of the dry matter. Water stress can be produced also by salt-alkali soil or cold (frost) soil as well (SINGH et al. 1973, BATES et al. 1973). Several researchers proved that the proline accumulated in great quantities in the leaves enhances the tolerance to dry weather and to rehydration (SINGH et al. 1972, 1973; ASPINALL et al. 1973; HSIAO 1973; PÁLFI et al. 1974, 1975; BLUM and EBERCON 1976; MALI and MEHTA 1977 etc.).

The function of free proline accumulated in the pollen and owing to water deficits in the leaves in significant quantities may in some respects be identical. According to VIRTANEN and KARI (1955), pollen in the course of ripening becomes highly deficient in water therefore there is a large quantity of proline in it.

In the course of our experiment, first we examined the pollen quantities and the water or dry matter content of pollens. The results obtained are presented in Table 1.

As is seen in Table 1, there were considerable deviations in the quantity of pollen scattered about by 40 plants in 12 hours, that is,with respect to the pollen production, by inbred lines. The smallest quantity of pollen is 1.35 g; while the greatest is 19.55 g fresh material; the difference is 15 times more than the other.

As has been mentioned in the Introduction, two of the lines examined were known by practical experience as having low pollen production and a depressed fertility value of the pollen. As regards pollen production in the course of 12 hours it was indeed, these two lines which gave the lowest values (SzV 13 and GK 72).

The water content in the pollen of the 10-kinds of lines presented a large interval. At the end of the 12 hours' collection, the water content extended

Table 1

The pollen quantity of inbred maize lines, and the water and dry-matter content of the pollen. The collection of pollen took 12 hours by lines from the tassel of 40 plants, at the time of the greatest pollination

(the water and dry-matter contents were calculated in the percentage of the pollen fresh weight)

Serial number	Signs of lines	Fresh weight	Dry-matter	Water content	Dry-matter content
		of the total pollen quantity of 40 plants, g		in percentage of fresh weight (%)	
1.	GK 13	6.40	5.76	10.00	90.00
2.	SzV 13	1.35	1.20	11.11	88.89
3.	B 37	1.61	1.26	21.74	78.26
4.	SzV 293	7.47	6.53	12.58	87.42
5.	B 14/A	12.80	8.03	37.27	62.73
6.	W 64 A	5.04	3.83	24.00	76.00
7.	W 153 R	4.31	3.80	11.83	88.17
8.	Oh43/301	10.50	6.74	35.81	64.19
9.	GK 72	1.50	1.36	9.40	90.60
10.	C 123	19.55	11.83	39.50	60.50
10/a	C 123 pollen of 5 plants	2.50	1.23	50.80	49.20

10/a = the pollen of only 5 plants, collected during 10 minutes, by shaking down the pollen (without waterloss, in fully fresh state).

from 9.4% to 39.5%, that is, the difference between the two extreme value was 400%. Nevertheless, the water content of the pollen measured immediately after having been shaken off the 5 plants was of 50.8% (10/a, C 123, Table 1). It can be inferred from the data that the pollen of maize after dissemination or pollination loses from its water content rapidly. But apart from this — as has been pointed out by other authors (STANLEY and LINSKENS 1974; BRITIKOV 1975) — the pollen of maize generelly remains alive for 24—48 hours after dissemination.

The water content of the two lines producing only a little pollen and with low fertility also is among the lowest (SzV 13 = 11.1% and GK 72 = 9.4%).

The dry-matter content of the pollens is generally very high, six eight times higher than that in leaves optimally supplied with water. If the dry-matter content of the leaves were identical with that of the pollen it would already mean a sublethal water shortage of the leaves. Under the development of such a serious water stress, the free proline content of maize leaves

Table 2

The free proline, total amino acid and soluble total protein concentration of the pollen of inbred maize lines in the percentage of the dry-matter
(proline is not calculated in the total amino acid)

Serial number	Signs of the lines	Free proline	Free total amino acid	Soluble total protein
		in the percentage of dry-matter		
1.	GK 13	2.17	1.55	5.53
2.	SzV 13	0.70	1.17	5.02
3.	B 37	2.17	1.35	6.05
4.	SzV 293	1.76	1.50	6.90
5.	B 14/A	1.96	1.88	5.28
6.	W 64 A	1.58	1.28	5.53
7.	W 153 R	1.78	1.05	6.40
8.	Oh43/301	2.57	1.20	5.53
9.	GK 72	0.90	1.50	5.93
10.	C 123	2.10	1.58	5.53
10/a	C 123 Shaken pollen	2.00 from 5 plants	1.52	5.58

10/a = the pollen of only 5 plants, which were collected by shaking down the pollens (without water loss, in completely fresh state).

also reaches an extremely high level (PINTÉR et al. 1977, PÁLFI et al. 1978). The proline, total amino acid and soluble total protein content of the maize lines examined is presented in Table 2.

The pollens of the inbred lines examined have been categorized into 4 groups on the basis of proline concentrations given in Table 2 and of the data from the specialized literature (PFAHLER and LINSKENS 1970, 1973; STANLEY and LINSKENS 1974; BRITIKOV 1975).

To the first group belong those inbred lines in the dry-matter of which the free proline surpasses the 2.0% level. This is the group with "very high" proline content. 4 inbred lines belong to this group: GK 13; B 37; Oh 43/301 and C 123.

The second group of "high proline level" contains those lines which have their proline concentration between 1.5% and 2.0%. Again 4 lines have been categorized in this group: SzV 293; B 14/A; W 64A and W 153R.

The third group would be represented by lines containing quantities between 1.0% and 1.5%, that is with "a medium proline content", but no line was found in this interval.

Two of the 10 inbred lines can be categorized into the fourth group, that is, the "low proline level", below 1.0%: SzV 13 and GK 72.

As can be seen from our data, the pollen fertility and water-binding ability (vitality) of the lines having "a low proline level", that is below 1.0%, showed a depressed value.

PFAHLER and LINSKENS (1970) examined such inbred maize lines which had good fertility and high production capacity. The proline concentrations of these lines were between 1.85% and 2.5%. As can be seen, our results confirm those obtained by the above authors with respect to the quantity of proline.

If we do take into consideration the high proline concentrations given in Table 2, the free total amino acid contents of the pollen of the lines generally give such values that are similar to those given by leaves optimally supplied with water (PÁLFI et al. 1978; PINTÉR et al. 1979). The total amino acid concentrations of the pollens, without proline, are between 1.0 and 2.0%. It should be noted however that the values obtained with the various lines do not correlate either in direct or reversed proportion, neither with the proline content, nor with the degree of vitality or fertility.

The proline content of the pollens in 8 of the 10 types of inbred lines examined surpassed to a significant extent the total concentration of free amino acids, even when taken singly. However, with two lines the proline content in comparison with that of the total amino acid showed a smaller value. These two lines were the very ones producing a small quantity of pollen and with weak fertility, viz. SzV 13 and GK 72.

Considering that the free total amino acid content of the 10 kinds of lines gave relatively constant values, we suggest as an index of vitality and fertility of pollens the ratio of "proline: total amino acid". The average without proline of the free total amino acid content of the 8 kinds of lines that obtained "high" and "very high" proline levels is 1.42%; the average of proline is 2.01%. From this, the ratio of "proline: total amino acid" amounts to 1.41.

In the two lines giving low, below 1.0% proline concentration, the average of the total amino acid is 1.33%, while that of proline is only 0.80% and from this the ratio of proline: total amino acid is 0.60.

The ratios of proline: total amino acid contents of lines showing advantages and weak fertility show a proportion of 1.41 to 0.60 that is, the difference is above 200% ! At the same time there is only a slight difference in the averages of the total amino acid contents of the two groups (lines) essentially different in their degree of fertility: 1.42 : 1.33.

17 kinds of free amino acids were detected from the pollen. However, no characteristic deviations were found in the qualitative composition and in the soluble total protein content of the amino acids between the lines of good fertility and low fertility (Table 2).

It is worth considering the advantages (functions) of free proline that accumulates in the extremely high concentrations of plant cells. For us, it is above all important to have the an especially high degree of solubility of

proline in water; in a quantity of 100 ml water of 25 °C a quantity of 160 g proline is soluble. This is the only protein-forming amino acid which in the case of a strongly reduced 20—40% water content of the cells can still be solved in high concentration, that is, it can be in a chemically active state.

In a normal case, it is the quantity of glutamic acid and aspartic acid that dominates among the free and bound amino acids of plants. In the course of transaminations, too, these two amino acids play a part mostly as an amino donor. At the same time, the solubility of glutamic acid in water is 192 times smaller than that of proline, while that of aspartic acid is 300 times smaller than that of proline. Besides, proline is exclusively produced from glutamic acid, while ATP and reducing energy is used up. After rehydration, proline re-transforms into glutamic acid and then its spared energy also becomes free for the purposes of other synthesis. This is the second important advantage of proline.

It is known that the medium of the various free amino acids, above a certain concentration, all have a toxic effect on plant cells, although to different extents. We have proved by means of biological tests that the high concentration of proline (0.5%) inhibits the growth of cells to the least extent among all the protein building amino acids (PÁLFI et al. 1974). This is the third important advantage of proline.

On the regulatory part played by proline in water metabolism (osmosis and hydratation), in respiration (in KREBS cycle) and in the permeability of membranes other authors have similar findings. BRITIKOV and LINSKENS 1974; BLUM and EBERCON 1977; PINTÉR et al. 1978, 1979). Besides, proline is also an indispensible component of proteins occurring in the wall of pollen tubes of 30—50 cm in maize (BRITIKOV 1975).

One of the uses of our experimental results is that if in hybridization we apply inbred lines of very high proline content for the father, we can by means of their pollination develop such seed vigourousness that will manifest its of not only in the germination of the seeds and by the stronger vitality of the developed plants but also in the greater quantity and better quality of the seed production in the successor plants (PFAHLER and LINSKENS 1970, 1973; STANLEY and LINSKENS 1974; BRITIKOV 1975).

According to the other practical implication, if we select (individually) through several years, the lines of "low level" and therefore weak fertility in combination with self-fertility and by the analyses of the pollens that survived, then it may be possible to produce male sterile pollen for "minus proline". AHOKAS (1978) found strongly reduced proline concentration in all the anthers or degenerated pollens of the male sterile cytoplasmic "msml" barleys. KWANGSI (1977) came to a similar conclusion, as well as YAMADA and KONO (1977) with the sterile pollens of inbred rice lines.

In our future research we should like to examine the proline content of pollen in hybrid maizes and in the inbred parents constituting them (in the same year of breeding). The examination of the free amino acid and proline content of several inbred lines and hybrid maizes of different genotypes also seems to be necessary, and simultaneously with them — the examination of the germination of fresh pollen in vitro.

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Acta Botanica Academiae Scientiarum Hungaricae, Tomus 27 (1—2), pp. 189—198 (1981)

CHANGES IN THE DIVERSITY OF THE VEGETATION DURING SUCCESSION*

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(Received 1 June 1980)

In one of the succession series in the course of foresting the sandy meadow, the changes in diversity of genus-species, species-relative cover, life form-species and life form-relative cover were examined. Diversities were the lowest in the closing association of the succession (*Convallario-Quercetum roboris*). The diversity in species-relative cover changes in the vegetation period; in certain associations it decreases from spring to autumn. The plant associations representing the individual stages of succession follow each other in such niche space where the humus and moisture content of the soil and the light conditions are its axes. In the course of vegetation succession on a given site newer associations occur. These new associations following each other represent certain stages of succession of the vegetation. The associations have their own organization. The extent of their organization can be expressed by diversity (MARGALEF 1968). Diversity is related to stability, by means of its ability to resist perturbations (McNAUGHTON 1968), therefore it may be an essential feature in qualifying the condition of environment. Therefore, in the ecological approach to environmental protection, diversity has a major part to play (JUHÁSZ-NAGY 1979).

Diversity in the associations following each other in succession, and in the stages, have been studied by several researchers (for example, AUCLAIR and GOFF, 1971; PATTEN 1962; WHITTAKER 1965; MELLINGER and McNAUGHTON 1975; etc.). The view has evolved in which it is considered that at the initial stages of succession diversity increases, while in the closing stage it decreases (MARGALEF 1968; WHITTAKER 1969; WUENSCHER 1974). The diversity changes ensuing during the secondary succession have been studied by e.g. ODUM (1960), SHAFI and YARRANTON (1973), NICHOLSON and MONK (1974) and BAZZAZ (1975). According to them diversity increases continuously during the secondary succession.

The comparative critical analysis of the results mentioned before have not yet been carried out.

In this paper the diversity of the separate stages of a theoretically established primary succession series will be discussed.

The succession series examined

ZSOLT (1943), with respect to the vegetation of the St. Andrew Island found the following succession series (with the names of associations used originally, those used today are given in brackets): *Brometum tectorum* → *Festucetum vaginatae* (*Festucetum vaginatae danubiale*) →

* Tece studies, No. 22.

Festucetum sulcatae (*Astragalo-Festucetum sulcatae*) → *Quercetum roboris convallerietosum* (*Convallario-Quercetum roboris*). The following abbreviations are used in this paper: *Brometum*, *Festucetum vaginatae*, *Festucetum sulcatae* and *Quercetum*.

It should be noted that there are at least two stages between *Festucetum sulcatae* and *Quercetum*. However the above study gives no details on these.

Some of the characteristic species of the associations, after ZSOLT (1943) and ZÓLYOMI (1958), are as follows: *Brometeum — Bromus tectorum*, *B. squarrosus*, *Secale silvestre*, *Cynodon dactylon*, *Kochia laniflora*, *Corispermum nitidum*, *Erysimum diffusum*, *Polygonum arenarium*, *Euphorbia seguieriana*, *Syntrichia ruralis*; *Festucetum vaginatae — Festuca vaginata*, *Syrenia cana*, *Centaurea arenaria*, *Fumana procumbens*, *Gypsophila arenaria*, *Sedum hillebrandii*, *Euphorbia seguieriana*, *Alkanna tinctoria*, *Onosma arenaria*; *Festucetum sulcatae — Festuca sulcata*, *Chrysopogon gryllus*, *Astragalus exscapus*, *Iris arenaria*, *Stipa capillata*, *S. pennata*, *Melandrium viscosum*, *Seseli varium*; *Quercetum — Quercus robur*, *Quercus cerris*, *Acer tataricum*, *Berberis vulgaris*, *Crataegus monogyna*, *Viburnum lantana*, *Pulmonaria mollissima*, *Cephalathera rubra*, *Lithospermum purpureo-coeruleum*, *Inula salicina*.

The cover of vegetation was in Brometum 30—85%, in Festucetum vaginatae 50—80% and in Festucetum sulcatae 90—100%. The shrub layer of *Quercetum* is dense (cover is 60—90%). The size of the sampling squares was 25 m^2 in grasslands, and 100 m^2 in forests. The humus content of the soil rises from *Brometum* towards *Quercetum*.

The succession mentioned occurred during the forestation of the sandy meadow (ZSOLT 1943, ZÓLYOMI 1958).

The Tece meadow of Vácrátót lies near to Szentendre (St. Andrew) Island (and it is natural reserve area). Ecological research on *Festucetum vaginatae* has been conducted here, for several years (FEKETE et al. 1980). The soil of Tece meadow largely corresponds to that of Szentendre Island. In this meadow, succession has reached the *Festucetum strictae* association (a stage between *Festucetum vaginatae* and *Festucetum sulcatae*). Theoretically, the succession series analysed in the above study is considered to be valid for the Tece sandy meadow as well.

Basic data and methods

ZSOLT, in the mentioned study presents the detailed tables on each of the associations, the time of sampling and the total species list as well.

The characterization and description of the associations were made according to the procedure of the Zürich-Montpellier School (BECKING 1957).

From the table presenting the similarities between the associations which represent the four stages (Table 1) it may be seen that there is most similarity between stages following each other.

The index of the degree of succession (DS) based on NUMATA's (1969) study was calculated separated for each sample and the averages were used for the characterization of the stages. (One sample of *Festucetum vaginatae*, No. 13, has been left out of the calculations

Table 1

Similarity-index values of the communities (Sørensen's similarity-index)

	Festucetum vaginatae	*Festucetum sulcatae*	*Quercetum*
Brometum	0.2817	0.2418	0.0087
Festucetum vaginatae	—	0.2594	0.0138
Festucetum sulcatae	—	—	0.0595

because the A—D value of *Populus alba* is too high compared with the small number of other species.) The *DS* index was calculated from the following equation (NUMATA 1969):

$$DS = \frac{\Sigma(d \cdot l)}{n} \cdot v,$$

where l = life-span of the species constituting the association,
d = dominance value,
n = number of species,
v = total cover between 0 and 1 (1 = 100% cover).

Life-span according to the life forms of RAUNKIAER: Th 1; Ch, H and G 10; N 50, M and MM 100.

The average *DS* values: *Brometum* 40, *Festucetum vaginatae* 83, *Festucetum sulcatae* 114 and *Quercetum* 1949. As can be seen the succession of stages is clearly distinguishable from the results.

The accidental species and the *Robinia pseudacacia* have been left out of our calculations.

The relative cover percentage of the individual species was used in calculating the diversity. The value of relative cover was calculated by applying the mean values of the BRAUN-BLANQUET-type A—D scale. In the total species list, the mean values for each of the species were calculated from the samples then these values were added up and the percentage cover of the species was expressed in the percentage of this sum. In the individual samples, the sum of the mean values of the cover by species was taken as 100%.

Species-genus diversity was calculated so that the number of species and genus occurring in the total species list was counted and also the number of genera to which 1, 2, 3 . . . etc. species belonged; we followed a similar procedure when calculating the life form-species diversity too.

Diversity (D) was calculated by means of SHANNON's function ($D = -\Sigma p_i \lg_{10} p_i$), and evenness ($V$) with the equation

$$V = \frac{D - D_{\text{l.min.}}}{D_{\text{l.max.}} - D_{\text{l.min.}}}$$

NOSEK (1976); p_i = relative coverage of ith species; $D_{\text{l.min.}}$ = local minimum of diversity; $D_{\text{l.max.}}$ = local maximum of diversity.

The problems of estimating the diversity are discussed in the book by PIELOU (1975), SHANNON's equation was chosen because most ecological studies dealing with diversity use it and in this way our results can be compared with theirs. In calculating the evenness of relative cover, $D_{\text{l.min.}}$ was obtained by taking 99% cover in one species and the remaining 1% was evenly distributed among the rest of the species. (In the Appendix, a table of species from 2 to 50 for $D_{\text{l.min.}}$ and for the difference between $D_{\text{l.max.}}$ and $D_{\text{l.min.}}$ is presented.) Naturally, an even lower $D_{\text{l.min.}}$ can also be produced.

Results on the basis of the synthetic species list

Most genera and species can be found in *Festucetum sulcatae*. In this association the genus-species diversity is the highest among the four associations. However the evenness is the lowest here (Table 2).

In the closing association of the succestion (*Quercetum*), the genus-species diversity is the lowest, the value of evenness, however, is not the highest.

The species richness and genus richness changes similarly to that of diversity values, in the four stages.

The life form-species diversity is of identical value in *Festucetum sulcatae* and *Quercetum* (accidental coincidence). Its value is the highest in *Festucetum vaginatae*, and the value of evenness is also the highest here (Table 3). In the

Table 2

Diversity (D) and evenness (E) values of the communities; genus—species and species—relative cover

Community	D	E	Genus	Species
			number	
Genus—species				
Brometum	1.6534	0.7966	47	56
Festucetum vaginatae	1.8317	0.7339	73	86
Festucetum sulcatae	1.9261	0.6620	96	126
Quercetum	1.6217	0.7699	46	59
Species—relative cover				
Brometum	1.1826	0.6669		
Festucetum vaginatae	1.1855	0.6051		
Festucetum sulcatae	1.3447	0.6323		
Quercetum	0.9500	0.5252		

Table 3

Diversity (D) and evenness (E) values of the communities; life form—species and life form—relative cover

Community	Life form—species		Life form—relative cover	
	D	E	D	E
Brometum	0.6162	0.4773	0.6120	0.6284
Festucetum vaginatae	0.7474	0.7192	0.6343	0.6526
Festucetum sulcatae	0.5889	0.5530	0.4380	0.4395
Quercetum	0.5890	0.4525	0.5589	0.5707

two small cover, open associations (*Brometum* and *Festucetum vaginatae*), the life form-species diversity is greater than in the closing association of large cover. This can be linked with the similar results of FEKETE and KOVÁCS (1978).

The life form-relative cover diversity and evenness are the lowest in *Festucetum sulcatae*. They showed almost the same low values in *Brometum* and *Festucetum vaginatae*. With respect to this diversity, *Quercetum* occupied an intermediate place among the associations.

Results on the basis of the releves

The species-relative cover diversity values in the individual releves showed great fluctuation in *Festucetum sulcatae*, while in *Festucetum vaginatae* and *Quercetum* fluctuation had small values (Fig. 1).

By grouping the releves according to the sampling periods, the diversity in species-relative cover in *Festucetum vaginatae* and *Festucetum sulcatae* decreases from spring to autumn (Table 4). Evenness in *Festucetum sulcatae*

Table 4

Changes of average diversity ($\bar{D}$) and average evenness ($\bar{E}$) values and that of the average species number of the communities during the vegetation period

	Month	*Brometum*	*Festucetum vaginatae*	*Festucetum sulcatae*	*Quercetum*	Average species number			
						Brometum	*Festucetum vaginatae*	*Festucetum sulcatae*	*Quercetum*
D	April	—	0.9420	—	—	—	28.0	—	—
	May	—	0.8048	0.8455	(0.8198)*	—	27.5	30.6	(27.0)
	June	0.7321	0.7746	0.7953	0.6137	20.5	23.5	31.6	17.3
	July	0.8469	(0.6375)	0.6866	0.6453	21.5	(18.0)	21.7	26.0
	September	(0.6903)	0.7562	0.6218	—	(15.0)	19.5	22.0	—
V	April	—	0.6444	—	—				
	May	—	0.5508	0.5869	(0.5609)				
	June	0.5475	0.5615	0.5264	0.4830				
	July	0.6322	(0.4931)	0.4994	0.4444				
	September	(0.5704)	0.5774	0.4434	—				

* Values in parentheses originating from a single releve.

changes similarly to diversity, while in *Festucetum vaginatae* it does not (Table 4).

By taking the averages of the individual releves with respect to species-relative cover, we can see that with the exception of *Quercetum* the diversity of the other associations is very similar and the standard error of diversity values does not show great differences either (Table 5). The average of evenness and its standard error decrease from *Brometum* to *Quercetum*. The average species number is the lowest in *Brometum* and *Quercetum*, and the greatest in *Festucetum sulcatae*.

The data of Tables 4 and 5 can be compared in a way that for example we remove from Table 4 the diversity values belonging to June, and compare
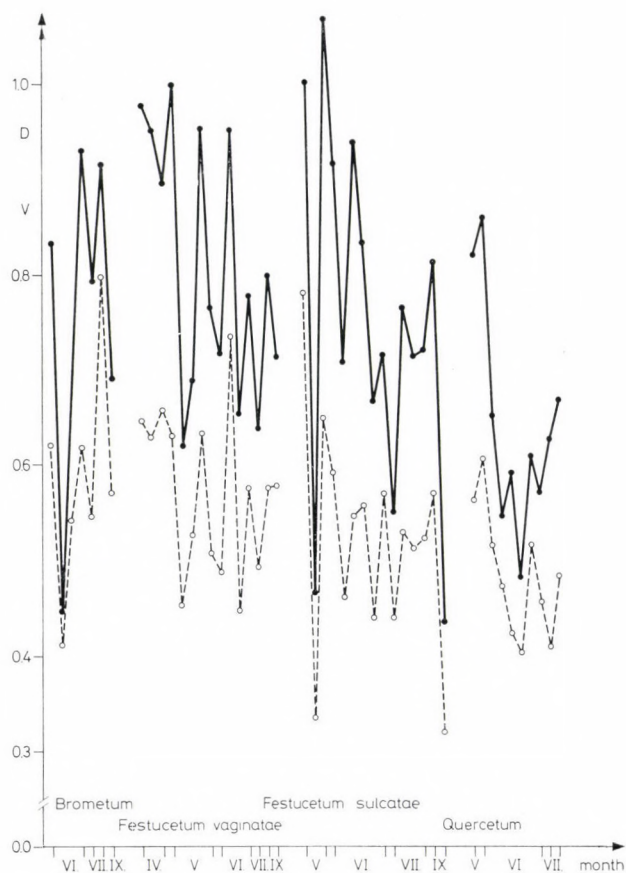
Fig. 1. Changes of species-relative cover diversity (*D*) and evenness (*E*) in communities; continuous lines: diversity, broken lines: evenness

Table 5

Average diversity ($\bar{D}$) and average evenness ($\bar{E}$) values in species—relative cover of the communities calculated from the samples

	$\bar{D}$	s	$\bar{E}$	s	$\bar{S}$	s	n
Brometum	0.7589	0.1633	0.5749	0.0922	20.00	6.27	7
Festucetum vaginatae	0.8066	0.1362	0.5721	0.0849	24.67	6.02	15
Festucetum sulcatae	0.7532	0.1847	0.5202	0.1166	29.53	9.05	15
Quercetum	0.6406	0.1181	0.4831	0.0665	20.00	6.04	10

$\bar{D}$ = average diversity; $\bar{E}$ = average evenness; $\bar{S}$ = average species number; s = standard error; n = number of samples.

them with the values of Table 5. We can see that diversity is the highest in *Festucetum sulcatae;* when using the values of July we find that maximum diversity occurs in *Brometum.*

Dominance-diversity curves and discussion

The dominance-diversity curves (WHITTAKER 1965) were drawn on the basis of the synthetic species list (Fig. 2). The importance value of the species was estimated by means of relative cover (in the Figure the ordinate is of a logarithmic scale; the species values on the abscissa are in the order of importance). The shape of the curves deviates especially in the lower section from that drawn by WHITTAKER. This can be attributed to the fact that there are many species of small cover in each community and no differentiation could be made in these species.

The *Brometum* and of *Quercetum* curves best approach the linear (Fig. 2). The curve of *Brometum* in not so steep as that of *Quercetum.* That the two curves approach the geometrical series can be explained by the rigorous environmental conditions (WHITTAKER 1965). However, in *Brometum,* the "desert" environment is decisive, while in *Quercetum* it is the level of groundwater. That is, there are two different factors that establish rigorous conditions for the vegetation. The low diversity of *Quercetum* can also be attributed to the fact that only a small number of species occurred in *Quercetum,* which might be due to the previously mentioned factor there. Furthermore, presumably the association had not yet reached its most developed, optimal phase, but was only in the initial stages of its development.

The shape of the curve of *Festucetum vaginatae* and *Festucetum sulcatae* in a semilogarithmic illustration approaches a sigmoid form (Fig. 2). This indicates that the environmental conditions are not so rigorous as in the case of *Brometum,* and that there is a relatively great number of species of moderate importance. It also indicates that there is a more intensified competition between species (WHITTAKER 1965) than in *Brometum.*

The curves of *Festucetum vaginatae* and of *Quercetum* show well that in these associations there is such a species occupying a larger part of the niche space. It seems that during succession the communities follow each other in such niche space (WUENSCHER 1974) the axes of which are the humus and the moisture content of the soil, as well as the light conditions.

The diversity in species-relative coverage is the lowest in the closing stage of succession. It can be inferred from this that the degree of an orvered state is the highest in this stage. The ordered state however, changes also within the individual association during the vegetation period, as is shown by *Festucetum vaginatae* and *Festucetum sulcatae* (Table 4). In these communities the organization increases from spring to autumn (entropy decreases).
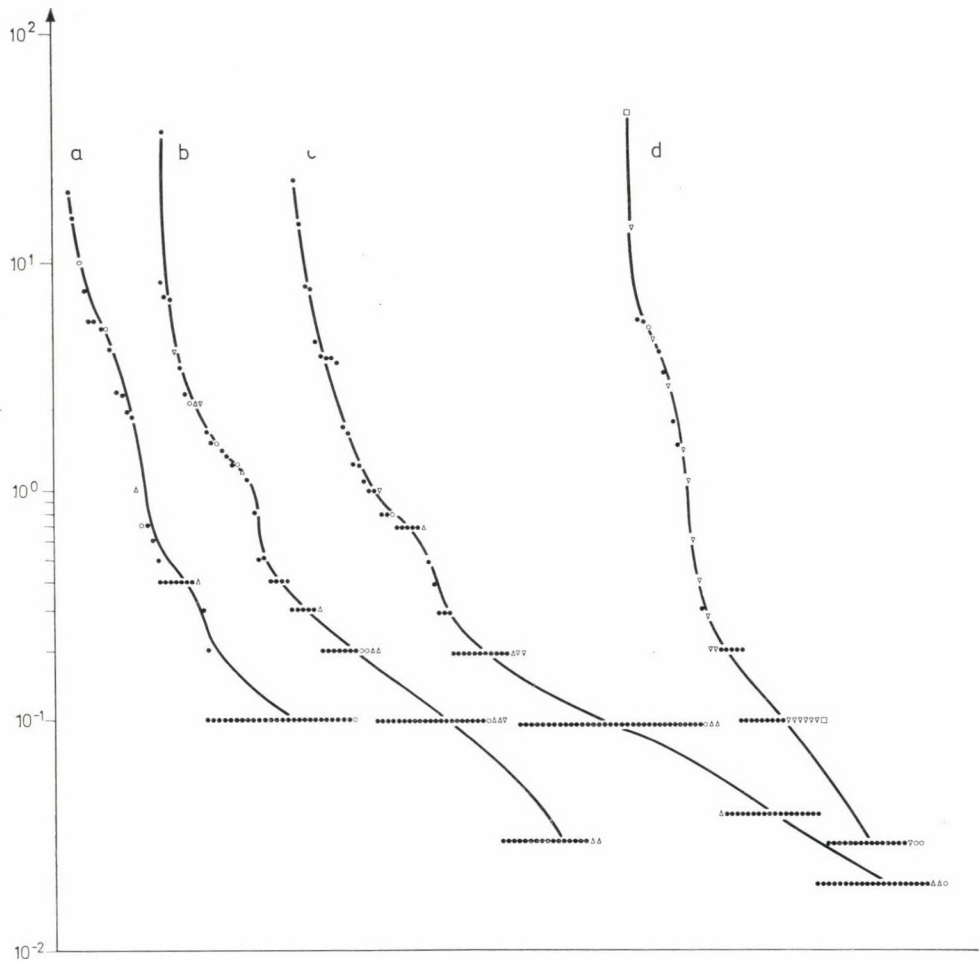
Fig. 2. The dominance-diversity curves of the communities (a = *Brometum;* b = *Festucetum vaginatae;* c = *Festucetum sulcatae;* d = *Quercetum.* ● = herbs, o = mosses, △ = lichen, □ = trees, ▽ = shrubs)

On the basis of the results it seems that the synthetic tables used by the Central-European cenological school can only be used for diversity examinations which is understandable for they were not prepared for any other purposes. Although the dominance-diversity curves presented were constructed by starting from the synthetic species list, it is not certain whether the best method was chosen.

It follows from the supposition related to the dominance-diversity curve of *Quercetum* that the developmental state of the associations (initial, optimal and degradational) should be known approximately and so comparisons between the diversity of associations at the same phase of development could be made.

In further studies on diversity changes within the vegetation period should also be taken into consideration (see the case of *Festucetum vaginatae* and *Festucetum sulcatae*). The example mentioned in connexion with Tables 4 and 5 indicates that it is not all the same when and in which association we make an estimation of diversity. The results obtained in the different vegetation periods indicate a kind of dynamism with respect to the diversity in the vegetation. The average of the whole vegetation period can be used to characterize the stages and is related to the dynamics of the vegetation differing from the preceding one.

Appendix

Increase in $D_{l.\,min.}$ depending on species number, when the cover of one species is 99% and the cover of all the other species is 1%

S	$D_{l.min.}$	Difference	S	$D_{l.min.}$	Difference
2	0.0243	0.2767	26	0.0383	1.3767
3	0.0273	0.4498	27	0.0385	1.3929
4	0.0291	0.5730	28	0.0386	1.4086
5	0.0303	0.6687	29	0.0388	1.4238
6	0.0313	0.7468	30	0.0389	1.4382
7	0.0321	0.8130	31	0.0390	1.4524
8	0.0328	0.8703	32	0.0392	1.4659
9	0.0333	0.9209	33	0.0394	1.4791
10	0.0338	0.9662	34	0.0395	1.4920
11	0.0343	1.0071	35	0.0396	1.5045
12	0.0347	1.0445	36	0.0398	1.5165
13	0.0351	1.0788	37	0.0399	1.5283
14	0.0354	1.1107	38	0.0400	1.5398
15	0.0357	1.1404	39	0.0401	1.5510
16	0.0361	1.1680	40	0.0402	1.5619
17	0.0363	1.1941	41	0.0403	1.5725
18	0.0366	1.2187	42	0.0404	1.5829
19	0.0369	1.2419	43	0.0405	1.5930
20	0.0371	1.2639	44	0.0406	1.6028
21	0.0373	1.2849	45	0.0407	1.6125
22	0.0375	1.3049	46	0.0408	1.6219
23	0.0377	1.3240	47	0.0409	1.6312
24	0.0379	1.3423	48	0.0410	1.6402
25	0.0381	1.3598	49	0.0411	1.6491
			50	0.0412	1.6578

S = species number; difference = $D_{l.\,max.} - D_{l.\,min.}$; using logarithm lg_{10}.

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Acta Botanica Academiae Scientiarum Hungaricae, Tomus 27 (1—2), pp. 199—209 (1981)

DIE PHÄNOLOGIE EINIGER OSTMEDITERRANEN GEOPHYTEN UND IHRE DARSTELLUNGSPROBLEME*

Von

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Author carried on ontogenetic and phenologic studies on about 800 hardy geophyton species during more than ten years. Enumerates the groups different caloric request illustrating each of them by East-mediterranean taxa and represents their phenograms by a new illustration method of phenological cycles. This phenogram consists of three concentric circlets makes possible a simple and clear-cut comparison: it shows together the periods of generative, vegetative and dormancy stadia of the species during the different seasons of the year; in addition the periods of some characteristic phases of the stadia by decads or pentads respectively.

As examples the ontogenetical phases of two species are also demonstrated.

Einleitung

In der Mitte des XVIII. Jahrhunderts mit der Tätigkeit von LINNÉ begann auch die Bildung der Pflanzenphänologie, die sich seit der zweiten Hälfte des vorigen Jahrhunderts immer kraftvoller weiterbildete. Eine historische Zusammenfassung der Geschichte der Phänologie ist in den Handbüchern von SCHNELLE (1955) und LIETH (1974) zu finden. Die neueren phänologischen Sammelwerke erstrecken sich auch schon auf die moderne, mechanische Bearbeitung der Daten.

Es beschäftigten sich ziemlich wenige Forscher mit den Abbildungsmethoden der phänologischen Angaben. Auf diesem Gebiet ist die Tätigkeit von KAJGORODOW, ALJOCHIN und SCHENNIKOW (1950) aus der Sowjetunion bedeutend. Einige Darstellungsmethoden der Lebenszyklen spontaner Zwiebelpflanzen finden wir in den Werken von ACHWERDOW (1955) und ARTJUSCHENKO (1970), andere Phänophasen-Darstellungen in den Büchern von SCHNELLE (1955) und LIETH (1974).

Nach den anfänglichen Beobachtungen von P. WIERZBICKI und A. KERNER begann in Ungarn M. STAUB im Jahre 1871 eine intensive phänologische Tätigkeit. Da aus dem Handbuch von SCHNELLE (1955) nicht einmal eine Erwähnung der ungarischen phänologischen Forschungen zu finden ist, verfertigte J. SZAKÁLY als Ersatz dieses Mangels eine vorzügliche, bündige, skizzenhafte Zusammenfassung (1965) über die Geschichte der ungarischen Pflanzenphänologie. In den 1870er Jahren wurde auch in Ungarn ein pflanzenphänologisches Beobachtungsnetz ausgebaut, und die einzelnen Stationen übten eine bedeutende Tätigkeit bis den I. Weltkrieg aus, und auch nachher — aber schon auf wenigeren meteorologischen Stationen weiter — bis die Zeit des II. Weltkrieges. Der meteorologische Hilfdienst wurde im Jahr 1951 reorganisiert, und seitdem gibt man jährlich systematisch phänologische Beobachtungen über eine ganze Reihe von wildwachsenden und Kulturpflanzen aus. Zwischen den Jahren der zwei Weltkriege ist die phänologische Tätigkeit von I. GYŐRFFY, Z. KEÖPECZI-NAGY, D. BERÉNYI und GY. MÁNDY erwähnungswert. Es erschienen auch viele phänologische Karten (hauptsächlich über den Blühbeginn): in der ersten Reihe von verschiedenen landwirtschaft-

* Vorgetragen in Istambul, am 4. Juli 1978, auf dem »II. Internationalen Symposium über die Probleme der balkanischen Flora und Vegetation«.

lichen Pflanzen und Obstbäume, aber auch von der Robinie, Linde, Flieder usw. In den letzten Jahrzehnten machten die synökologischen Forschungen auch in Ungarn Fortschritte (z.B. I. MÁTHÉ und Mitarbeiter; SZUJKÓ-LACZA und FEKETE 1973; SZUJKÓ-LACZA et al. 1976), deren Dezimalmethoden auch schon für eine komputerisierte Bearbeitung der einzelnen Phänophasen geeignet sind.

Zwischen den wildwachsenden Zwiebelpflanzen wird auch in Ungarn die erst blühende Schneeblume mit Vorliebe beobachtet (SZAKÁLY 1965). Es gibt noch eine ländliche Beobachtungsreihe über die Herbstzeitlose; ausser diesen erstreckten sich die anderen Forschungen nur auf einige Zierpflanzengattungen (z. B. *Tulipa*, *Gladiolus*), im Bezug der Gartensorten.

Forschungsergebnisse

Die pflanzenphänologischen Untersuchungen zeichnen am meisten den Beginn des Blühens auf. Die winterharten Zwiebel- und Knollengewächse können unter den ungarischen Klimaverhältnissen im grossen und ganzen in vier Blühperioden gruppiert werden. Die erste Gruppe ist die früheste (von Februar bis zur ersten Hälfte von März): zum Blühbeginn genügt hier schon eine sehr geringe Wärmemenge (Tagesmittelwert: 2—4 °C). Die bekanntesten Vertreter dieser Gruppe sind: *Galanthus*-, *Crocus*-Arten, *Leucojum vernum*, *Eranthis*, einige frühe *Scilla*-Arten und ihre Verwandten (*Puschkinia*, *Chionodoxa*), die im Frühjahr blühenden *Colchicum*- und *Iris*-Arten.

Dieser Gruppe folgt eine andere Vorfrühlingsgruppe (Blütezeit von der zweiten Hälfte von März bis Anfang Mai), deren Blühbeginn aber bei höherer Wärmemenge (ungefähr 8—10 °C Tagesmittelwert) einsetzt. Solche sind die früh blühenden *Muscari*-, die meisten *Tulipa*-, *Narcissus*- und *Fritillaria*-Arten, *Leucojum aestivum*, viele *Ornithogalum*-Arten usw. Die Vertreter dieser beiden Gruppen ziehen sich aber schon ungefähr im Monat Juni zurück. — Der Wärmeanspruch der dritten Gruppe — gegenüber der zwei vorangehenden — liegt schon beträchtlich höher. Diese Pflanzen brauchen zum ihren Aufblühen (aber auch schon zum Ausspriessen) viel höhere Tagesmittelwerte: bedeutend über 10 °C. Diese Arten blühen in Ungarn erst vom Ende Mai, im Juni und Juli. Hierher gehören die meisten *Allium*- und *Lilium*-Arten, die mediterranen Gladiolen, *Muscari comosum* u. a. Die Mehrheit dieser Arten — der vorigen zwei Gruppen gegenüber — sind auch im Sommer grün belaubt, und ziehen sich nur im Herbst zurück. — Die letzte, vierte Gruppe fängt bei uns erst nach der Beendigung der grossen Sommerhitze zu blühen an: vom August bis zum Oktober (einige blühen sogar bis zu den ersten Frosttagen). Dazu können viele *Colchicum*- und *Cyclamen*-Sippen, die um Herbst blühenden *Crocus*-, *Scilla*-, *Allium*-, *Leucojum*- und *Sternbergia*-Arten gezählt werden.

Wenn wir aber nicht nur die Blütezeit der Arten, sondern das Erscheinen der Blütenknospe bzw. der Infloreszenz, die Dauer der Fruchtreife, ferner die Phänologie der vegetativen Organe (z. B. den Beginn der Blattvergilbung)

und endlich auch die Dauer der Ruheperiode (Dormantie) berücksichtigen, erhalten wir ein viel komplizierteres Bild. Dies wiederspiegelt aber — im Falle einer entsprechenden Abbildungsmethode — viel genauer den tatsächlichen Phänorhythmus und den phänologischen Charakter der Arten.

In der Reihe meiner ausführlichen, mehr als zehnjährigen und sich auf ungefähr 800 Geophytentaxa beziehenden Beobachtungen in Ungarn (und zum Teil auch in Ausland) zeigten sich ziemlich bedeutende Abweichungen zwischen den verschiedenen Taxa, hinsichtlich ihres phänologischen Charakters. Bei ein und demselben Taxon waren die jährlichen Abweichungen meistens nur bei den ersten zwei Gruppen (Arten des Vorfrühlings) auffallend, während die einzelnen Phasen anderer Arten die meisten Jahre hindurch sich in den gleichen Dekaden — manche sogar in den gleichen Pentaden — vollgezogen haben.

Um die Phasen der vegetativen und generativen Stadien bzw. die Dauer des Einziehens parallel demonstrieren zu können, dient ein von mir (Priszter 1971, Isépy und Priszter 1972, Priszter und Isépy 1974, Priszter 1974, Priszter 1975) eingeführtes komplexes (jedoch einfaches) Phänogramm (s. Abb. 1). Dieses Phänogramm — in ihrer gegenwärtigen, verbesserten Form —
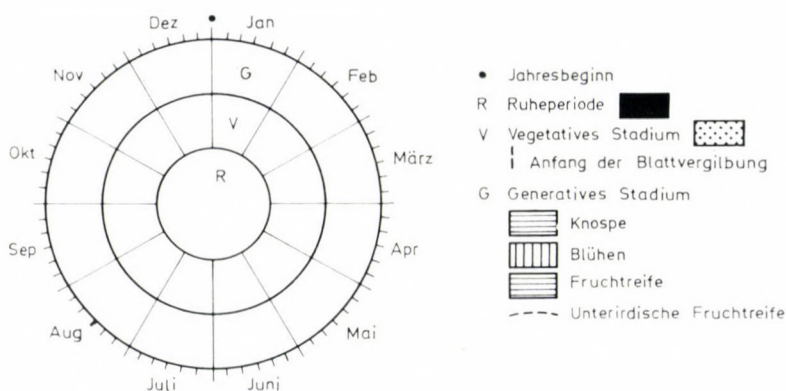
Abb. 1. Schema des Phänogrammes

besteht aus drei konzentrischen Ringen. Der innerste davon (»R«, schwarz markiert) bedeutet die Dauer der Dormantie, der zweite (»V«, punktiert) das vegetative Stadium (mit Angabe des Beginns der Blattvergilbung), der äusserste (»G«, verschiedenartig schraffiert) die drei Phasen (Knospe, Blühen, Fruchtreife) des generativen Stadiums. Die 12 Segmente repräsentieren die 12 Monate, in Pentaden aufgeteilt. Mit Hilfe dieses Phänogramms können teils der Eintritt und das Aufhören (also die Dauer) der Stadien bzw. der Phasen fixiert werden, wodurch die Phänologie verschiedener Taxa miteinander leich-

ter vergleichen werden kann, und endlich ermöglicht diese Abbildungsmethode die Feststellung der abweichenden phänologischen Typen. Aus den von mir untersuchten, beiläufig 100 balkanischen Geophyten führe ich diesmal die Phänogramme von 12 Arten vor (Abb. 2—13). Die einzelnen Phänophasen
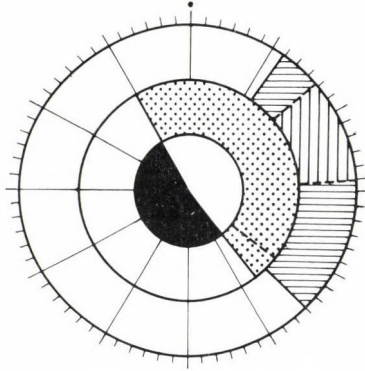
Abb. 2. Galanthus nivalis L.
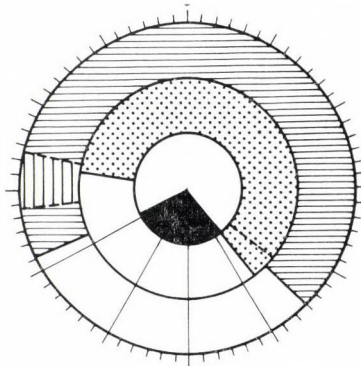
Abb. 3. Galanthus nivalis L. ssp. *reginae-olgae* (Orph.) Gottl.-Tann.
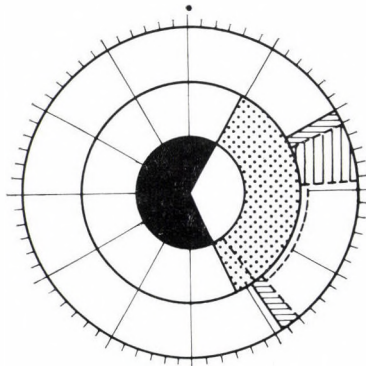
Abb. 4. Crocus tommasinianus Herb.

kann man daneben auch durch Habitusbilder veranschaulichen. Dazu nur 2 Proben. Bei *Fritillaria meleagris* L. (Abb. 14) repräsentieren *A* und *B* das vegetative, *C—J* das generative Stadium (*C—F*: Knospenzustand, *G*: Blühen,
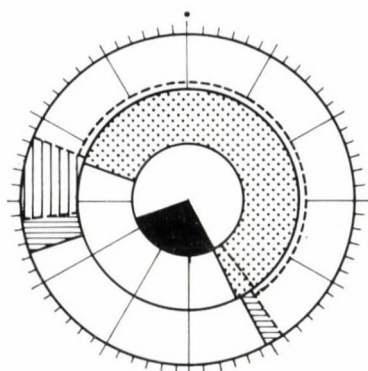
Abb. 5. Crocus speciosus Bieb.
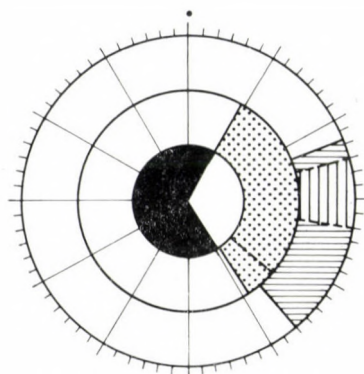
Abb. 6. Scilla sibirica Haw. in Andrews
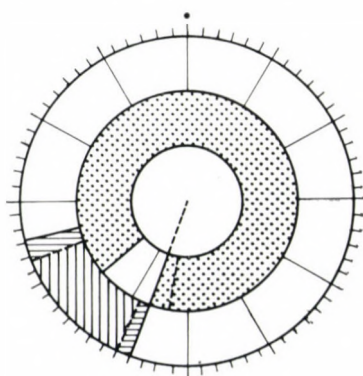
Abb. 7. Scilla autumnalis L.

H—J: Fruchtreife); bei *Scilla sibirica* Haw. (Abb. 15) bedeutet *A* das vegetative, *B—G* das generative Stadium (*B—C*: Knospenzustand, *D—E*: Blühen, *F—G*: Fruchtreife).
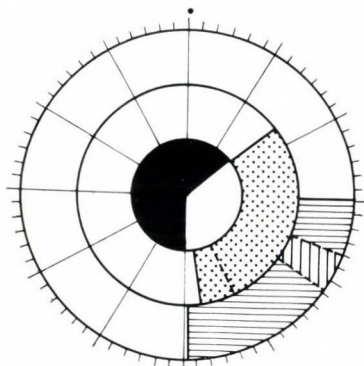
Abb. 8. Tulipa sylvestris L.
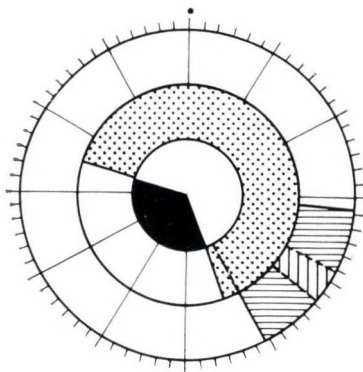
Abb. 9. Tulipa saxatilis Sieb. et Sprengel
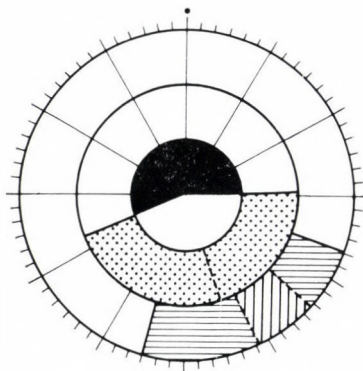
Abb. 10. Asphodelus albus L.

Die Dormantie kann bei den Vorfrühlingsblütlern in Ungarn eine 6—8 monatliche Dauer erreichen (Abb. 2, 4, 6), während bei den anderen Arten dieser Zeitraum viel kürzer ist (Abb. 5, 12, 13). Bei einigen Arten dauert das
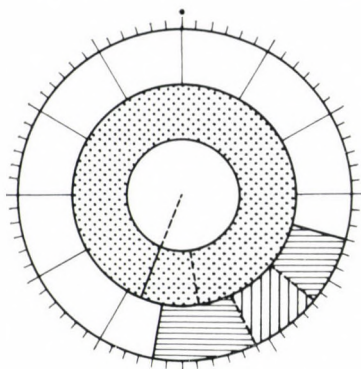
Abb. 11. Asphodeline lutea (L.) Rchb.
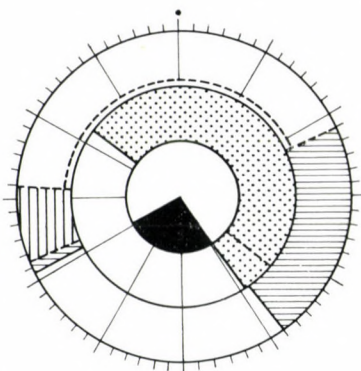
Abb. 12. Sternbergia colchiciflora W. et K.
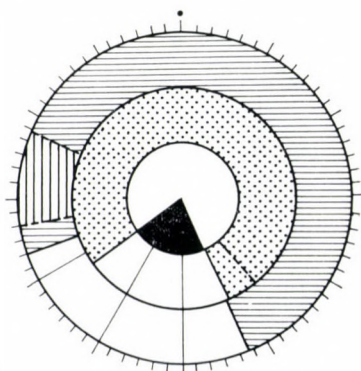
Abb. 13. Sternbergia lutea (L.) Ker-Gawl.

Einziehen nur einige Wochen lang, es gibt sogar Arten, die — mit Ausnahme der extrem dürren Sommerjahre — fast keine Ruheperiode zeigen (z. B. *Allium flavum* L.; Abb. 7, 11).
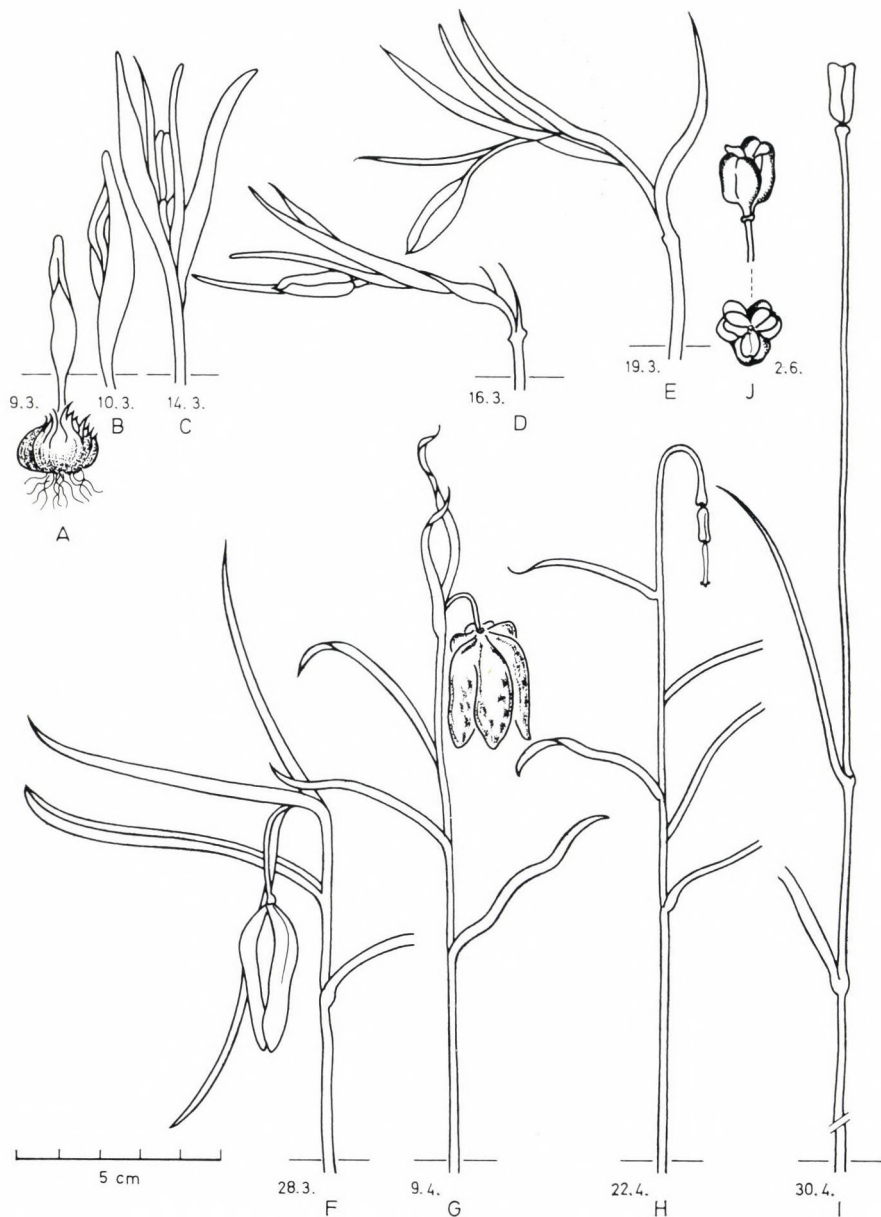
Abb. 14. Phänophasen von *Fritillaria meleagris* L. (Zeichnungen von M. P.-SCHUMI)

Das vegetative Stadium ist von sehr veränderlicher Dauer (vgl. z. B. Abb. 4, 6, 8 und 3, 7, 11) und weist eine charakteristische Korrelation mit den verschiedenen Phasen des generativen Stadiums auf. Im typischen Fall

Abb. 15. Phänophasen von *Scilla sibirica* Haw. (Zeichnungen von M. P.-Schumi)

entwickeln sich die Blätter mit dem Blühen zusammen (Synanthie) oder ein wenig früher (Abb. 4, 6, 8, 10). Ausserdem ist es wohl bekannt, wie sich mehrere im Herbst blühende *Colchicum*- und *Crocus*-Arten verhalten: nach dem Verblühen (ohne Blätter: Hysteranthie) schaltet sich eine winterliche Ruheperiode ein, und im nächsten Frühling entwickeln sich dann die Blätter mit der später erscheinenden Frucht zusammen (z. B. Abb. 5). Mehrere Herbstgeophyten bringen dagegen noch im selben Herbst reife Samen (z. B. *Muscari parviflorum* Desf.; *Scilla autumnalis* L.: Abb. 7). Bei anderen Arten wieder überwintert die noch unreife Frucht, und die Samen werden erst am Anfang des kommenden Sommers reif, mit dem Verwelken (Vergilbung) der Laubblätter zur gleichen Zeit [so z. B. *Cyclamen neapolitanum* Ten., *Galanthus nivalis* L. ssp. *reginae-olgae* (Orph.) Gottl.-Tann., *G. corcyrensis* (Beck) Stern, *Sternbergia lutea* (L.) Ker-Gawl.; Abb. 3, 13].

Die meisten Zwiebelpflanzen blühen im Frühling und im Sommer, nur wenige im Herbst (z. B. Abb. 3, 5, 7, 12, 13). Einige Herbstgeophyten (z. B. Abb. 5, 12) halten ihre noch unreife Früchte bis zu dem nächsten Frühjahr unter der Erde (auf dem Phänogramm durch gebrochene Linie markiert), obgleich ihre Blätter noch im Herbst erscheinen und so überwintern.

Die Fruchtreife und das Verdorren der vegetativen Organe laufen meist parallel. Manchmal beginnt aber die Blattvergilbung bedeutend früher, schon am Anfang des Blühens (z. B. bei *Allium flavum* L. und bei mehreren anderen *Allium*-Arten). Im anderen Fall dagegen bleiben die Blätter nach dem Verblühen unverändert grün und üben ihre Assimilationstätigkeit meistens auch nach der Fruchtreife noch lange restlos aus (z. B. *Allium victorialis* L., *A. obliquum* L., *Lilium martagon* L. u. a.).

*

Als Grund der oben erwähnten Phänorhythmen dienten meine eigene Beobachtungen und Messungen in dem gleichen Versuchsgarten (Budapest: Rózsavölgy). All die beobachteten ungarischen, sowie die Mehrheit der ausländischen Arten wurden in ihrem natürlichen Standort (als Zwiebel oder als Same) gesammelt: grösstenteils sind sie Klone, meist dieselbe Individuen. Die im Garten erhaltenen phänologischen Angaben sind Durchschnittsergebnisse der letzten 10—12 (bei einigen Arten sogar der letzten 20—25) Jahre, auf demselben Gebiet, mit gleichem Pflanzenmaterial.

In vielen Fällen bestand mir die Möglichkeit einen grösseren Teil meiner phänologischer Daten der heimischen Arten mit Individuen der originellen Standorten in natürlichen Pflanzengesellschaften zu vergleichen, und ich erfuhr vernachlässigbar geringe Unterschiede: nur einige Tage. Diese Angaben sind also auf die heimischen Gebiete mit ähnlicher geologischen und ökologischen Gegebenheiten gut verwendbar, sie können aber auch bei Phänophasenuntersuchungen der Geophyten der umgebenden mitteleuropäischen Gebieten als nützliche Stützpunkte dienen.

Zusammenfassung

Die seit mehr als 200 Jahre lang geübten pflanzenphänologischen Beobachtungen erstreckten sich auf relativ wenigen Arten der Zwiebel- und Knollenpflanzen. Aus den vergleichenden Untersuchungen des Autors, die mit etwa 800 Zwiebel- bzw. Knollenpflanzenarten auf demselben Feld seit 10—12 Jahre durchgeführt wurden, hat sich gezeigt, dass — zwischen mittelungarischen Verhältnissen — die spontanen heimischen und im Freiland kultivierbaren anderen ausländischen Geophyten — in erster Reihe aufgrund ihrer Wärmeansprüche — in 4 Blütengruppen eingereiht werden können. (Es gibt 2 Frühlings-, 1 Sommer- und 1 Herbstgruppen.) Wenn aber nicht nur das — bisher am meisten geforschtes — Blühbeginn, sondern auch die anderen Phänophasen berücksichtigt werden, und diese Daten bei denselben Individuen, auf gleichem Standort längere Jahre hindurch aufgezeichnet werden, so kann man schon an der Reihe von 10—15 Jahren Durchschnittsangaben mit zuverlässiger Genauigkeit erhalten. Einige aus solchen Angaben wird hier vom Verfasser durch seiner eigenen Abbildungsmethode dargestellt. Dieses Phänogramm besteht aus drei konzentrischen Ringen und zeigt gemeinsam im Laufe der 12 Monate eines Jahres die dormante, vegetative und generative Stadien des betreffenden Taxons. Auf jedem Phänogramm sind innerhalb des vegetativen Stadiums die Phänophase des Ausspriessens (das Erscheinen der Blattknospe), die Dauer des vegetativen Sprosses, die Phänophasen der Blattvergilbung und des Einziehens; innerhalb des generativen Stadiums das Erscheinen der Blütenknospe, die Dauer des Blühens, sowie die Phänophase der Fruchtreife dargestellt. Mit dieser einfachen Methode kommt man zu einer klaren Übersicht und Vergleich mit der Darstellung des Entwicklungsrhythmus auch anderer — nicht nur geophytischer — Pflanzenarten.

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Acta Botanica Academiae Scientiarum Hungaricae, Tomus 27 (1—2), pp. 211—214 (1981)

MONOCLEA FORSTERI HOOK. EN CUBA

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(Recibido 1 de Septiembre, 1980)

The monotipic family of *Monocleaceae* is new from Cuba. *Monoclea forsteri* Hook., the only representative of the family, occurs in damp, shady sites of carstic and of montane rain forest, between 400 and 1200 m altitudes. Maps of Cuban and of worldwide distribution are given. As *Monoclea* shares many vegetative characters and often its habitat with the oceanic cosmopolite *Dumortiera hirsuta* (Sw.) Nees, distinguishing features of the two genera are described.

El género *Monoclea* pertenece a la familia monogenérica *Monocleaceae*, fue elevado al rango de género por Hooker en 1820 teniendo como especie tipo a *Monoclea forsteri* Hook.

Se han descrito dos especies de este género *Monoclea forsteri* Hook. y *Monoclea gottschei* Lindenb. no obstante, todo parece indicar que ambas especies son una misma especie, *Monoclea forsteri* Hook., lo que hace a esta familia, monotípica.

Este género no había sido reportado antes para Cuba, al revisar los herbarios de *Hepáticas* de HAC y de EGR se han encontrado varios ejemplares de *Monoclea forsteri* Hook. colectadas en Cuba.

Estas plantas presentan forma taloide, son robustas, de un color verde intenso que en algunas llega a ser casi negro, presentan una estructura dorsiventral formada por varias capas celulares que forman un tejido compacto; en las células se pueden observar oleocuerpos dispersos así como cloroplastos discoides más o menos abundantes; el talo se puede presentar ramificado ligeramente dicotómico, nunca acintado, con los bordes lobulados en el cual aparecen pequeñas escamas transparentes; el talo carece de innovaciones terminales y de poros epidérmicos; en la cara ventral se disponen los rizoides lisos o escasamente engrosados, no aparecen escamas ventrales ni línea media.

En el material colectado aparece una planta con esporofito, unisexual femenina. Las plantas son dioicas. El arquegonio presenta un largo cuello y está rodeado de células musilaginíferas filiformes Hässel de Menéndez (1963) plantea que los anteridios se encuentran hundidos en cavernas, agrupados en recéptaculos sésiles, que los anteridios agrupados en estos receptáculos de forma ovoide están situados en la porción media del talo. El esporofito presenta un pedúnculo largo y fino el cual lleva en su porción apical la cápsula de forma

Fig. 1. Distribución de *Monoclea forsteri* HOOK. en Cuba

discoide y color pardo con la caliptra hialina, las células de la cápsula presentan engrosamientos semianulares, el o los esporofitos salen de los repliegues que se encuentran en escotaduras de la parte apical del talo por su cara dorsal donde se encuentran protegidos los receptáculos femeninos. Las esporas son pequeñas, esféricas, verrucosas. Eláteres con las dos bandas helicoidales engrosadas, con los extremos aguzados.

Este género se puede distinguir del género *Dumortiera*, con el que se confunde, por la consistencia compacta de su talo con bordes lobulados, en los ejemplares de herbario el color de *Monoclea* es verde intenso y en *Dumortiera* oliváceao, no así en el campo donde presentan un color parecido; en el talo
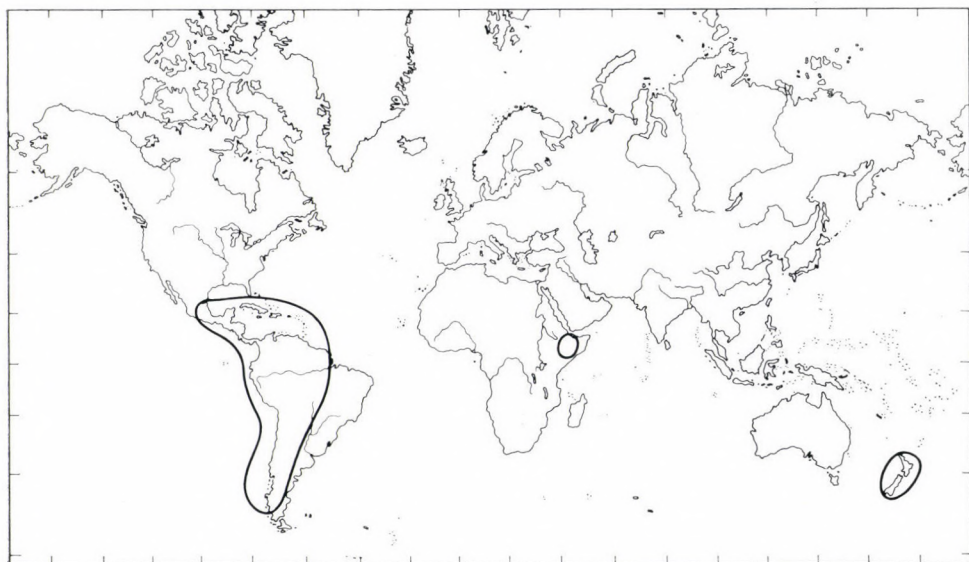
Fig. 2. Distribución de *Monoclea forsteri* HOOK. en el mundo

de *Dumortiera* marcadamente dicotómico y acintado aparecen innovaciones terminales y linea media, todo lo que no se aprecia en los talos de *Monoclea* que, a diferencia del de *Dumortiera*, poseen en sus bordes escamas pequeñas y transparentes, los receptáculos femeninos en *Dumortiera* están en discos hemisféricos dispuestos sobre la linea media, mientras que en *Monoclea* aparecen repliegues en forma de bolsa hacia las escotaduras del talo; el género *Monoclea* siempre es dioico mientras que *Dumortiera* puede ser dioico o monoico.

La especie *Monoclea forsteri* Hook., fue colectada en 1935 por J. Acuña sobre rocas húmedas y sombreadas a la orilla del Rio Taco-Taco en Rangel, provincia de Pinar del Rio; sobre suelos y troncos húmedos y sombreados del Alto del Babiney en la zona del Pico Turquino y sobre rocas húmedas y sombreadas en pluvisilva de montaña de El Caldero también en la zona del Pico Turquino en la provincia de Santiago de Cuba. En 1975 fué colectada por A. Borhidi sobre rocas sombreadas del Mogote de Faustino en la Sierra de la Güira provincia
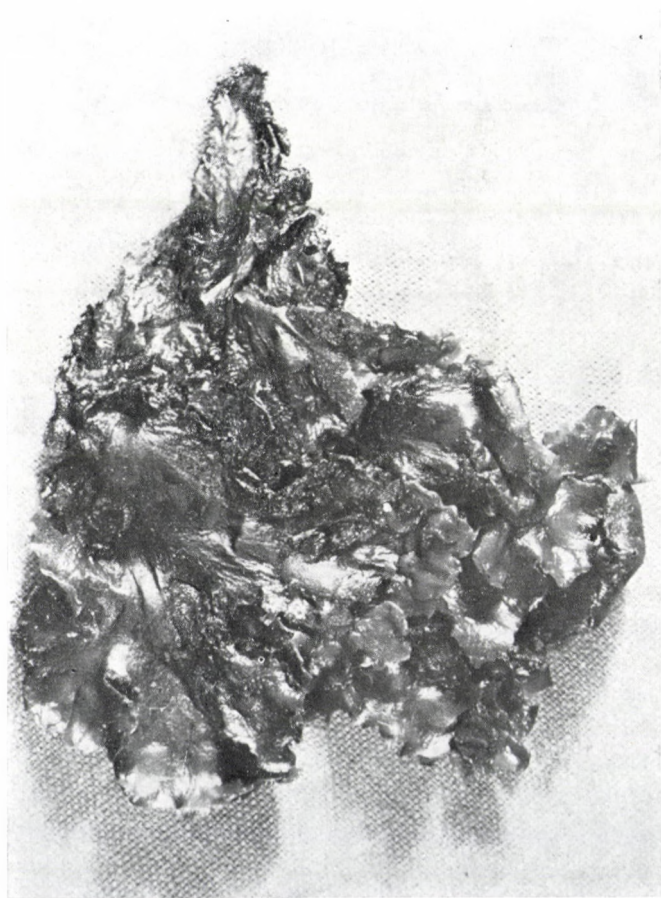
Fig. 3. Aspecto general de *Monoclea forsteri* Hook.

de Pinar del Rio. En 1976 fue colectada por D. Reyes sobre rocas húmedas y sombreadas a la orilla del Rio Negro en La Gran Piedra provincia de Santiago de Cuba. En 1979 fue colectada por T. Pócs sobre suelo de bosque húmedo lluvioso con muchos helechos arborescentes en la ladera S Loma La Sabina entre los 1100 y los 1200 m en la zona del Pico Turquino.

Distribución geográfica: Argentina, Bolivia, Chile, Colombia, Costa Rica, Cuba, Guadalupe, Guatemala, Jamaica, Juan Fernández, México, Peru, Puerto Rico, Venezuela, Abyssinia y Nueva Zelandia.

Material estudiado: CUBA, provincia de Santiago de Cuba, El caldero, J. Acuña 22140 (HAC). Pico Turquino, J. Acuña 22147 (HAC). Alto del Babiney, J. Acuña 22140 (HAC). Loma La Sabina T. Pócs 9085/AP (EGR). La Gran Piedra, D. Reyes 651 (HAC), Pócs, Reyes 9057/H (EGR, HAC). Provincia de Pinar del Rio; El Rangel, J. Acuña 22050 (HAC); Mogote de Faustino, Sierra La Güira, A. Borhidi 2385 (HAC, EGR).

PUERTO RICO: Canovanas, F. M. Pagán 271 (HAC). Cubuy F. M. Pagán 296 (HAC). El Yunque, F. M. Pagán 1001 (HAC). Sierra de Luquillo, F. M. Pagán 4240 (EGR). MÉXICO: Lagunas de Zempoala 14 km W Tres Cumbres, SW México D. F. und Cuernavaca; Frahm 792338 (EGR).

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Acta Botanica Academiae Scientiarum Hungaricae, Tomus 27 (1—2), pp. 215—222 (1981)

FURTHER DATA ON THE WATER REGIME IN BEECH FOREST TYPES

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(Received 30 October 1979)

The beech forest types of Hungary have been categorized into 8 grades according to the rate of their water regimes (MAJER 1956). The categorization implied a great number of subjective elements, therefore, by adapting the work of LAATSCH (1969) to beech forests in Hungary, the author made an attempt to determine the categories of the various forest types by means of an objective index. The present study contains the description and assessment of the results obtained by his method, while data related to the various sites are given in a separate table.

Already two decades have passed since A. MAJER (1956) set up a system for categorizing the forest types in Hungary. He placed his forest types in an ecological frame work, that is he distinguished 8 categories by water regimes in the given sites (extremely dry, very dry, dry, semi-dry, fresh, semi-moist, moist and watery). This categorization by the rate of water regimes had many subjective elements. The latest research results dealing with the relationships between forest and water may eliminate this subjectivity to a certain extent. Some of the results are presented below.

With respect to water regimes in individual forest types. LAATSCH's work was adapted (1969). He worked out the quantity of water that can be bound and stored in an easily available form in a layer of 1 decimeter thickness in soils with different physical properties, that is, the extent of their utilizable water capacity.

On the basis of his tests carried out in Bavaria, LAATSCH found that the useful water capacity of the individual soil types was of the following quantity:

Soil type	Useful water capacity (expressed in mm/dm)
Sand	7
Slightly loamy sandy	11
Loamy sand	14
Considerably loamy sand	18
Sandy loam	20
Loamy clay	17
Clay	13

Since the quantity of easily available water is also influenced by the humus content of the soil, LAATSCH took also this characteristic of the humus quantity into consideration when making his calculations, and, therefore, raised the rate of utilizable water capacity — if the soil layer was humous — by the following gradients:

Humus content	Additional water capacity (mm/dm) in case of	
	sandy	loamy soil
up to 1%	1	—
1— 2%	3	2
2— 4%	6	4
4— 8%	12	8
8—15%	20	16

Since the forest soils, mainly those on hilly regions are often stony, the quantity of stone decreases the thickness of the soil layers suitable for storing water, therefore, corrections should be made.

The useful water capacity of the rootable depth of a soil profile can be calculated. LAATSCH drew the lower line of a rootable depth where the density of the rootlet makes up 10% of the quantity to be found in the upper 20 cm soil layer. On this basis, the useful water capacity of the whole soil profile can be calculated, and LAATSCH took 50% of the quantity as easily available water. If the daily water consumption of spruce and other forests is 3 mm, then it can be calculated for how many days the easily available water quantity would be enough for the forest without further moisture supply. Thus, from now on, the individual grades of water regimes can be numerically characterized by the number of days in a way described above. LAATSCH worked out a value scale also for this, namely, if the available water lasts

for more than 45 days, the site is very fresh
31—44 days, fresh
26—30 days, from semi-dry to fresh
21—25 days, semi-dry
15—20 days, moderately dry
4—14 days, dry
7 days, very dry

We tried to apply the above conception for local conditions. Since the original sampling material had been obtained from spruce forests in Bavaria, we tried to find such sampling areas in our climatic zone which could best approximate those of LAATSCH's investigations.

The most appropriate were the soil samples collected by Z. JÁRÓ in long-term experimental plots of beeches. The sampling plots of his collection all lie in the climatic zones of beeches that is in Hungarian conditions, where spruce forests can also be successfully planted, therefore, the daily 3 mm water quantity which is considered the rate of water consumption can also be calculated with the least errors. The 113 soil diagnosis contained not only the description of the site but also the results of laboratory examinations, and satisfactory information was also provided with them so that the forest types could be determined as well. Therefore, the values of all the factors were available that could help us in calculating the readily available water supply of the soil, moreover the link with the vegetation that indicated the forest type could also be evaluated. To calculate the readily available water quantity, LAATSCH presented also a model calculation; on the basis of this the easily available water quantity as well as the number of days for which the water supply would be enough without repeated water replenishment to capacity (which is to be expected after snowbreak). Our data are given in a table and the key to the abbreviations is as follows: ABE = lessivated brown

forest soils, RBE = rusty-brown forest soil, BFÖLD = braunerde, RA = ranker, RE = rendzina, bRE = brown rendzina, vaRE = red-clayey rendzina, SBE = strongly acidic brown forest soil, PBE = podsolic brown forest soil.

The following inferences can be drawn from the table 1:

The water reserve expressed in terms of days is a suitable index for enabling us to distinguish forest types characteristic of the individual water regime categories. In taking the data included in the table on an average for forest types, the following numbers of water reserve days are characteristic of the individual water regime categories:

Of the *Melica uniflora* type indicating a dry water regime category: 39 days (1 sample); of the *Carex pilosa* type characteristic of the semi-dry water regime category: 28.5 days (32 data); in the semi-dry *Luzula albida* type: 25 days (2 data); in the semi-dry *Festuca drymeia* type: 16.7 days (4 data); in the *Asperula odorata* type, characteristic of the fresh water regime category: 39.4 days (33 data); in the semi-moist *Aegopodium podagraria* type: 45 days (1 sample); in the semi-moist *Lamium galeobdolon* type: 45.3 days (3 data); in the semi-moist *Oxalis acetosella* type: 38.5 days (4 data). It can be concluded from this that it would be reasonable to increase the number of data in most of the types examined. Only the *Carex pilosa* and the *Asperula odorata* types have a satisfactory number of data. In their case also the extent of variance was calculated. In the first case it was 14.087; in the second case, 13.69. Thus, the relevant data show the occurrence of rather high values of error. It can be inferred that the plants mentioned above as indicators for forest types are sensitive also to other ecological factors the effect of which is still to be explored. It has been examined in what soil types the quantity of easily available water supply expressed in number of days is lower than the average. It has been found that a number of days lower than the average is to be found in the case of soil types stony to a rather high extent (ranker, rendzina, and strongly acidic brown forest soil) the rootable depth in them is also thin or, of a medium depth, while data higher than the average are from lessivated brown forest soils. This indicates that this soil type has a favourable effect on the growth of beeches. Rendzina and other stoney soils enumerated are suitable for beeches only if the lower water capacity of the soil is compensated by a favourable distribution of annual precipitation.

From the data in the table inferences may be drawn with regard to the number of days during which the given soil types have enough water reserve to make them suitable and necessary for the cultivation of stands of certain wood species of good (yield classes I—II), medium (yield classes III—IV) and of poor (yield classes V—VI) woodproducing capacity that can be considered for the areas examined. The calculation of this capacity was carried out in the following way.

Table 1

Deisgnation of the sample-plot	Soil type	Rootable depth, cm	Utilizable water capacity, cm	Easily available water, mm	Water reserve day	Plant species indicating the forest types
Eszteregnye 14/b	ABE	122	245	124	41	*Asperula odorata*
Eszteregnye 3/b	ABE	174	367	183	62	*Asperula odorata*
Eszteregnye 1/b	PBBE	150	340	170	57	*Asperula odorata*
Farkasgyepű 23/c	ABE	95	196	98	33	*Carex pilosa*
Farkasgyepű 24/b	ABE	190	390	195	65	*Carex pilosa*
Füzér 51/a	RA	55	61	30	10	—
Füzér 10/b	RA	100	110	55	18	*Carex pilosa*
Füzér 115/f	RA	55	118	59	20	—
Füzér 59/a	RA-BFÖLD	110	168	84	28	*Carex pilosa* *Luzula albida*
Füzér 54/a	RA	95	110	55	18	*Asperula odorata*
Füzér 110/e	RA	40	67	33	11	—
Füzér 110/d	RA-ABE	50	73	36	12	*Carex pilosa*
Füzér 55/b	RA	120	92	46	15	—
Gyöngyös 32/b	ABE	135	129	64	22	*Carex pilosa*
Gyöngyös 33/a	RA	125	188	94	31	*Asperula odorata*
Gyöngyössolymos 6/a	RA	116	131	66	22	*Carex pilosa*
Gyöngyössolymos 31/c	PGABE	145	204	102	34	*Carex pilosa*
Gyöngyössolymos 32/a	ABE	120	90	45	15	*Carex pilosa*
Gyöngyössolymos 38/a	ABE	133	141	70	23	—
Karád 17/a	BFÖLD	140	298	149	50	—
Karád 15/c	ABE	87	180	90	30	*Carex pilosa*
Karád 15/b	BFÖLD	90	181	90	30	*Carex pilosa*
Kőszeg 47/a	PBE	90	95	48	16	*Festuca drymeia*
Kősheg 40/c	RA	100	108	54	18	*Festuca drymeia*
Kőszeg 34/a	SBE	125	253	126	42	*Festuca drymeia*
Kőszeg 45/a	SBE	90	110	55	18	—
Kőszeg 45/a	SBE	110	157	79	26	—
Kőszeg 47/b	PBE	90	138	69	23	—
Kőszeg Városi erdő	SBE	120	98	49	16	*Festuca drymeia*
Lesenceistvánd 45/d	ABE	125	313	156	52	*Carex pilosa*
Lesenceistvánd 55/b	ABE	130	268	134	45	*Aegopodium* *Mercurialis* *Circaea*
Mályinka 48/c	ABE	90	203	102	34	*Carex pilosa*
Mályinka 46/c	ABE	85	200	100	33	*Asperula odorata*

Miskolc 20/a	LHE	80	125	63	21	*Carex pilosa*
Miskolc 8/a	vaRE	70	48	24	8	*Carex pilosa*
Miskolc I/171/b	vaRE	70	82	41	14	—
Miskolc I/111/b	SBE	60	58	29	10	*Asperula odorata*
Miskolc I/110/a	BFÖLD	80	82	41	14	*Asperula odorata*
Nagyvisnyó 31/a	RA	80	131	65	22	—
Nagyvisnyó 47/a	RE	60	82	41	14	*Mercurialis perennis*
Nagyvisnyó 39/c	bRE	60	82	41	14	—
Nagyvisnyó 40/c	bRE	60	93	46	16	—
Nagyvisnyó 50/d	bRE	80	122	61	20	*Mercurialis perennis* *Asperula odorata*
Oltárc 46/b	ABE	125	259	129	43	*Carex pilosa*
Oltárc 42/b	ABE	138	279	139	46	*Asperula odorata*
Oltárc 37/a	ABE	163	331	165	55	*Carex pilosa*
Oltárc 36/x	ABE	108	221	110	37	*Asperula odorata*
Oltárc 36/a	PGABE	158	325	162	54	—
Oltárc 5/c	ABE	110	229	114	38	*Asperula odorata*
Pécsvárad 19/b	ABE	98	101	50	17	—
Pilismarót 156	RA-BFÖLD	120	147	73	24	*Luzula albida*
Pilisszentlélek 28/A	RA	80	137	68	23	*Lamium galeobdolon*
Pilisszentlélek 37/A	BFÖLD	120	115	58	19	*Mercurialis perennis*
Pilisszentlélek 36/a	ABE	130	268	134	45	*Lamium galeobdolon*
Porva 12/c	ABE	138	276	138	46	—
Porva 15/d	ABE	150	315	158	52	*Asperula odorata*
Porva 15/b	PGBE	120	250	125	42	*Asperula odorata*
Pusztavám 45/c	BFÖLD	50	92	46	15	—
Pusztavám 42/a	BFÖLD	100	149	111	37	*Asperula odorata-Lamium galeobdolon* *Asperula odorata*
Pusztavám 1	ABE	75	109	55	18	*Asperula odorata*
Pusztavám 2	ABRBE	120	142	106	35	*Carex pilosa*
Pusztavám 3	ABE	110	148	111	37	*Asperula odorata-Carex pilosa*
Sümeg g/3	ABE	88	113	56	19	—
Szokolya 25/c	ABE	85	156	78	26	*Carex pilosa*
Szokolya 16/b	RA	80	192	96	32	*Mercurialis perennis*
Szokolya 26/h	RA	50	79	39	13	*Carex pilosa*
Szücs 34/h	vaRE	90	87	44	14	*Carex pilosa*
Szücs 25/c	PGABE	120	260	130	43	*Oxalis acetosella*
Szücs 39/d	ABE	100	206	103	34	*Carex pilosa*

Table 1 (continued)

Designation of the sample-plot	Soil type	Rootable depth, cm	Utilizable water capacity, cm	Easily available water, mm	Water reserve	Plant species indicating the forest types
Szücs 14/c	ABE	120	258	129	43	*Oxalis acetosella-Asperula odorata*
Szücs 5/c	ABE	135	279	140	47	*Asperula odorata*
Szücs 15/b	ABE	80	169	84	28	—
Szücs 16/a	ABE	110	224	112	37	*Asperula odorata*
Szücs 19/c	ABE	120	247	123	41	*Asperula odorata*
Szücs 21/f	ABE	130	263	132	44	*Asperula odorata*
Szücs 22/c	BFÖLD-ABE	140	304	152	51	*Asperula odorata*
Szücs 23/b	ABE	110	156	78	26	*Oxalis acetosella-Lamium galeobdolon*
Szücs 36/b	ABE	88	188	94	31	*Carex pilosa*
Tolmács 134/c	ABE	105	218	109	36	—
Tormaföde 16/c	ABE	125	258	129	43	—
Tormaföde 41	ABE	125	258	129	43	*Asperula odorata*
Ugod 28/d	ABE	100	200	100	33	*Carex pilosa*
Ugod 30/m	ABE	120	247	123	41	*Dryopteris filix-mas*
Ugod 35/a	ABE	92	190	95	32	*Carex pilosa*
Ugod 27/g	ABE	90	184	92	31	—
Ugod 31/d	ABE	120	252	126	42	*Oxalis acetosella*
Ugod 38/d	ABE	113	235	117	39	*Melica uniflora*
Valkonya	ABE	110	229	114	38	*Asperula odorata*
Varbó 80/c	baRE	80	91	45	15	*Carex pilosa*
Varbó 79/b	baRE	80	105	52	18	*Asperula odorata*
Varbó 82/a	BFÖLD	80	87	44	15	*Carex pilosa*
Valkonya	ABE	110	229	114	38	*Asperula odorata*
Velem 11/b	SBE	110	136	68	23	*Asperula odorata*
Velem 10/b	SBE	110	68	51	17	*Carex pilosa*
Visegrád 24/a	RA átmABE	140	182	91	30	—
Visegrád 24/a	ABE	150	312	156	52	*Carex pilosa*
Visegrád 35/a	ABE	120	274	137	46	*Asperula odorata*
Visegrád 73/c	ABE	120	264	132	44	—
Visegrád 74/c	RA	80	101	51	17	*Carex pilosa*
Visegrád 74/c	RA	200	136	68	23	*Carex pilosa*
Visegrád 74/c	RA	80	101	51	17	—
Visegrád 75/b	ABE	200	241	120	40	—

Visegrád 79/a	Ra	92	134	67	22	—
Zajk 35/a	ABE	185	380	190	63	—
Zala 8	ABE	105	217	108	36	—
Zalacsány 4/s	BFÖLD	140	285	142	48	—
Zalaújlak 5/d	ABE	100	209	105	35	—
Zirc 20/b	ABE	190	391	196	65	*Asperula odorata*
Zirc 21/a	ABE	170	407	203	68	*Lamium galeobdolon*
Zirc 22/a	ABE	110	261	131	44	*Carex pilosa-Asperula odorata*
Zirc 26/a	ABE	170	347	173	58	*Asperula odorata*
Zselickislak 18/b	ABE	95	195	98	33	*Carex pilosa*
Zselickislak 18/b	BFÖLD	200	418	209	70	*Carex pilosa-Asperula odorata*

To each of the site samples, the tree species suggested by JÁRÓ (1972) for the given site type, as well as the probable growth values of the tree species, were grouped in accordance with the three categories mentioned above (good, medium, poor). According to the results, for the good growth of a beech forest within the climate zone of beeches such water-storing capacity of the soil is necessary that is equivalent to the water consumption of the soil during 39.54 (±13.229) days. Similarly, for a medium growth of a beech-wood, the quantity of readily available water reserve should be enough for 23.33 ± 10.86 days; for its poor growth, 18 ± 4.61; for the good growth of spruce forests, 37.01 ± 13.72; for its medium growth 23.15 ± 12.058; for a good growth of other pine woods 37.49 ± 14.46; for their medium growth 22.88 ± 12.39; for the good growth of Scotch pines, 22.38 ± 11.27; for their medium growth 20.00; for their poor growth 18.00 ± 4.60. From the data it can be observed that the water requirement of beeches and spruce forests is higher than that of Scotch pine which is more moderate.

Summary

The site diagnosis carried out on experimental stands in beech forests marked in various sites in Hungary enabled calculating the easily available water quantity in the soil of the single sample-plots and from this, the water regime of beech forest types could be determined in an objective way. There is a correlation between the index of easily available water reserve, the forest types indicating the single water regime category, and the wood-producing capacity of the tree species that can be grown in the given site. The relevant work of LAATSCH was adapted to the conditions in Hungary, and used for the elaboration.

Finally, I should like to express my gratitude to all those who provided valuable assistance in preparing my work, mainly to ZOLTÁN JÁRÓ who put the results of his site-diagnosis work at my disposal, to LÓRÁNT KOVÁCS and TAMÁS LACZAY, my fellow-workers, who carried out the various calculations which were necessary for this study, and — last but not least — to dr. GISELLA JAHN, Professor of Forestry at the University of Göttingen, who provided me with the valuable specialized literature, and called my attention — among others — to LAATSCH's work cited above.

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Acta Botanica Academiae Scientiarum Hungaricae, Tomus 27 (1–2), pp. 223–264 (1981)

GROWTH ANALYSIS OF RED PEPPER VARIETIES

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(Received 1st June 1980)

In this paper, the growth analysis of two red pepper varieties (KM-622; KV-1) will be presented. The investigations were carried out in habitats ideal for red pepper growth, and in one which was unfavourable for pepper varieties, so that data could be obtained on the effect of habitat differences on the growth and the quantity of yield

The paper describes the foll owing growth characteristics: RGR, RLGR, NAR LAR, spec. LA and LWR. With the growth analysis it was hoped to obtain information on the periodical changes in growth indices related to varieties and on the extent of distinct differences in growth and assimilation rates of the varieties. The relationships between growth characteristics and crop weights were examined.

The effect of external factors on the variability of growth characteristics and crop quantity was studied by means of path analyses, in both habitat areas and in both varieties.

Introduction

Red pepper, owing to its role in Hungarian food consumption, foreign export, and in pharmaceutical utilization, is one of the indispensable plants of Hungarian agriculture. Hungarian red peppers, which are of excellent quality and acknowledged even in world market, owe their taste, flavour and pigment content primarily to the favourable climatic conditions of the growth areas (Szeged, Kalocsa), and to soils rich in nutrients which warm up rapidly. In Hungary, the crop growing of red pepper varieties look back to past of almost 150 years. During this period, a series of red pepper varieties of excellent quality and high yields—resistant to diseases caused by viruses—have been propagated by specialists. Success in this work and the efficiency of production have been promoted by large-scale scientific research which in the past 15 years has shown a great upswing. These researches covered — among others — a detailed analysis of the optimal environmental requirements of red pepper varieties, and of the natural resources of the growing areas as well as the scientifically based modernization of the technologies in large-scale production and manufacturing (KAPELLER 1971, MÉCS 1969, SZŰCS 1961, 1967, 1973, 1975).

The aim of our examinations

The present study deals with the growth analysis of two red-pepper varieties. Growth in this case is defined as increase in dry weight of the plants, as well as in leaf area. The rate of growth in red-pepper individuals, and the periodical changes in growth rate of individual plant parts were tested by means of growth analyses.

When producing new varieties, breeders take into consideration primarily the intensive growth, early riping and high productivity of the plant. Therefore, a detailed analysis of growth processes was considered necessary and important, and also the relationship between the yield and the size of the assimilating system, by applying the method of growth analysis.

From effective selection of genotypes, it may be useful for breeders to know what relationships exist between the quantity of the crop and the individual growth characteristics (see: NEČAS 1965, 1968; SCHWARZE 1956; HART 1978; WILHELM and NELSON 1978). In this study these relationships will be described.

The investigations were carried out in areas optimal, and disadvantageous for red-pepper varieties, viz. Kalocsa and Vácrátót. It was hoped to ascertain the effect of local climatic and habitat differences on growth on the quantity of the crop as well as the external environmental factors on the variability of growth characteristics and of the quantity of the crop in both localities.

In connexion with our growth analyses CO_2 assimilation and iodine tolerance of these varieties were also studied in detail.

The conditions of the analysis

The examinations were carried out in 1978, the Research Centre for Red-pepper of Kalocsa, on two red-pepper varieties grown under large-scale production conditions namely varieties KM-622 and KV-1, and in the experimental area of the Research Institute for Botany of the Hungarian Academy of Sciences, at Vácrátót, on the stand bred from planting the two varieties of Kalocsa, mentioned above. The most important economic and meteorological data are given in Tables 1 and 2.

A short characterization of the two varieties

KM-622:

With short stalk ramification, and thin foliage. Upright fruit position, semi-determined variety (Fig. 1). Early ripening. Breeder: Ferenc MÁRKUS.

KV-1:

Tall, strong growth, characteristic crotched ramification of the stem. Hanging fruit position; a high degree of resistance to diseases. Constantly-growing variety (Fig. 1). Early ripening, a very spicy variety. Breeder: Károly KAPELLER and János SZIRMAI.
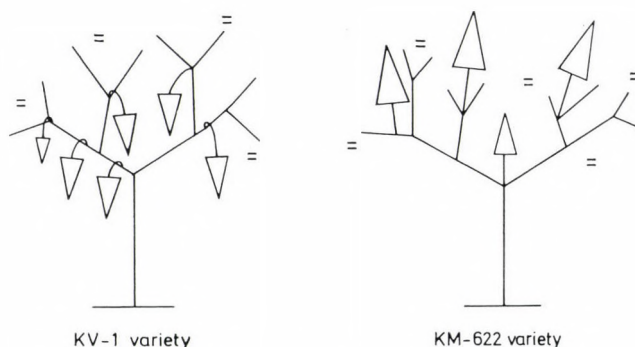
Fig. 1. Rough morphological sketch of the *Capsicum* varieties

Table 1

Some important agricultural data

Locality	Variety	Soil	Time of planting	Distance between rows resp. tillers	Number of tillers (3 tillers in 1 dump)	Time of harvest	Mean yield weight	Treatments
Kalocsa	KM-622	hard sandy soil	19.5	60×15	300,000 number/ha	12.9	98.23 q/ha fresh weight	treatments with Wuxal (0.4%)
	KV-1	hard sandy soil	19.5	60×20	250,000 number/ha	4.10	80.09 q/ha fresh weight	watering
Vácrátót	KM-622	hard loam	5.6	50×15	60 number/m²	5.10	16.95 g/plant dry weight	fertilizing with Arvalin
	KV-1	hard loam	5.6	50×20	50 number/m²	5.10	14.60 g/plant dry weight	watering

Table 2

Some important meteorological data in the breeding season

Locality / Month	Total precipitation (mm)	Absolute maximum of temperature	Absolute minimum of temperature	Average of daily mean temperature	Daily mean of radiation minimum	Monthly amount of sunny hours
		°C				
Vácrátót						
May	27.0	24.2	1.0	13.5	7.4	187.2
June	95.5	26.6	6.5	18.3	10.6	273.9
July	73.8	27.4	9.0	18.9	11.1	299.3
August	40.6	29.0	6.2	18.4	9.9	287.1
September	17.9	27.2	3.4	14.8	7.7	213.4
October	19.2	22.3	2.6	11.2	4.8	186.5
Kalocsa						
May	66.2	25.6	0.6	13.9	8.1	182.4
June	84.2	28.4	8.8	17.8	10.7	256.5
July	54.5	29.7	8.2	18.9	11.4	303.6
August	22.7	31.3	5.2	18.8	10.7	275.5
September	22.8	29.8	2.9	15.2	8.3	182.4
October	4.4	25.7	—1.1	11.3	3.4	166.2

Material and methods

Sampling

On each sampling, 5 individuals of the same development were collected together with the root system intact. In the early quick phase of growth, samples were taken in periods of 10—14 days. For the sampling periods see Tables 5—8.

The methods applied in the processing of the samples

The individuals collected, after separation of the flowers and fruits for weighing, were pressed, then the surface of the leaves was measured.

Table 3

Linear regression equations between the leaves area (x) and the leaves weight (y) in the sample periods, Vácrátót

b: regression coefficient — b_d: difference of regression coefficients — s_d: standard deviation of difference of regression coefficients — N: number of data — r: correlation coefficient

Sample period	Linear equation ($y = a + bx$)	b_d	s_d	t
KM-622				
14. 6— 6. 7	$y_1 = -0.0043 + 0.0050x$ $N = 20$ $r = 0.8956^{***}$			
14. 7— 2. 8	$y_2 = -0.0057 + 0.0069x$ $N = 20$ $r = 0.8655^{***}$	$b_2 - b_1 = 0.0019$	0.0014	1.3571 ns
8. 8—31. 8	$y_3 = -0.0492 + 0.0094x$ $N = 20$ $r = 0.7201^{***}$	$b_3 - b_2 = 0.0025$	0.0022	1.1363 ns
7. 9— 5. 10	$y_4 = 0.0410 + 0.0060x$ $N = 25$ $r = 0.7512^{***}$	$b_3 - b_4 = 0.0034$	0.0022	1.5454 ns
KV-1				
14. 6— 6. 7	$y_1 = -0.0038 + 0.0048x$ $N = 20$ $r = 0.8523^{***}$			
14. 7— 2. 8	$y_2 = -0.0223 + 0.0075x$ $N = 20$ $r = 0.8728^{***}$	$b_2 - b_1 = 0.0027$	0.0015	1.8000^{+}
8. 8—31. 8	$y_3 = -0.0051 + 0.0061x$ $N = 20$ $r = 0.7443^{***}$	$b_2 - b_3 = 0.0014$	0.0021	0.6666 ns
7. 9— 5. 10	$y_4 = 0.0287 + 0.0043x$ $N = 25$ $r = 0.7363^{***}$	$b_3 - b_4 = 0.0018$	0.0015	1.2000 ns

*** Significant at 0.001 probability level
+ Significant at 0.10 probability level

Table 4

Mathematical definitions and dimensions of the growth characteristics used
(A = leaf area — W = total plant weight)

Relative Growth Rate (BLACKMAN 1919; BRODY 1945)	$\overline{\text{RGR}}$	$\frac{1}{W}\frac{dW}{dt} = \frac{\ln W_2 - \ln W_1}{t_2 - t_1}$	g g^{-1} d^{-1}
Relative Leaf Growth Rate	$\overline{\text{RLGR}}$	$\frac{1}{A}\frac{dA}{dt} = \frac{\ln A_2 - \ln A_1}{t_2 - t_1}$	cm^2 (cm^2)$^{-1}$ d^{-1}
Net Assimilation Rate (BRIGGS, KIDD and WEST 1920; GREGORY 1926)	$\overline{\text{NAR}}$	$\frac{1}{A}\frac{dW}{dt} = \frac{\ln A_2 - \ln A_1}{t_2 - t_1} \cdot \frac{W_2 - W_1}{A_2 - A_1}$	g (cm^2)$^{-1}$ d^{-1}
Leaf Area Ratio (BRIGGS, KIDD and WEST 1920)	$\overline{\text{LAR}}$	$\frac{A_{1\,leaf} + A_{2\,leaf}}{W_{1\,total} + W_{2\,total}}$	cm^2 g^{-1}
Leaf Weight Ratio	$\overline{\text{LWR}}$	$\frac{W_{1\,leaf} + W_{2\,leaf}}{W_{1\,total} + W_{2\,total}}$	g g^{-1}
Specific Leaf Area (EVANS and HUGHES 1960)	$\overline{\text{spec. LA}}$	$\frac{A_{1\,leaf} + A_{2\,leaf}}{W_{1\,leaf} + W_{2\,leaf}}$	cm^2 g^{-1}

Measuring and calculation of the leaf area

At each sampling, the surface area of 5 leaves each was measured by a planimeter then the weight of the leaves was determined one by one after drying at 85 °C, by means of analytical balance. The value of the leaf area, conforming to the international literature, refers to one side of the leaf blade (CARLISLE, BROWN and WHITE 1966).

The total leaf area of the individuals was calculated from linear regression equations between dry weight and area of the planimetred leaves, by knowing the dry weights of all the leaves (KEMP 1960, COOPER 1960, CORMACK and BATE 1975) (see: Fig. 2).

As regards the regression coefficients of the equations, there is a noteworthy difference in the varieties of the cultivated area of Kalocsa, while the regression coefficients do not differ significantly in relation to the two varieties of Vácrátót. It can be stated that in both cultivated areas, the regression coefficient values of the KM-622 variety are higher than those of the other variety, that is, the weight values falling to one unit of the leaf area are here gradually higher than those of the KV-1 variety. From this it can be supposed, that the assimilation activity is more efficient in the KM-622 variety. The leaf tissue structure and also the translocation taking place from the leaves can be different in the varieties, and they can also be the cause of various correlations between the surface area and the weight of the leaves in the varieties.

With respect to the varieties grown at Vácrátót, the correlation analyses were carried out also separately by samplings, or in certain cases by grouping the samples (Table 3), Although the significance test of the differences in regression coefficients did not show statistically acceptable differences in hardly any cases, it should be emphasized that the periodical changes, differing by varieties, in the regression coefficients can be characteristic, and their detailed analysis can provide newer information on the life-functions of the varieties.

Table 5

Seasonal changes in the mean value of total plant weights and the weights of certain plant organs, as well as the leaf area, Kalocsa, KM-622 variety

Date of sampling	Root (g)	Stem (g)	Leaves			Flowers (g)	Yields		Total plant weight (g)
			(g)	(cm²)	[mg (cm²)⁻¹]		(g)	(%)	
19. 5	0.07	0.06	0.07	8.40	8.33	—	—	—	0.20
5. 6	0.19	0.12	0.16	16.16	9.90	—	—	—	0.47
20. 6	0.23	0.26	0.59	53.23	11.08	—	—	—	1.08
27. 6	0.26	0.59	0.87	77.37	11.24	0.06	—	—	1.78
4. 7	0.38	0.74	1.05	92.88	11.30	0.07	—	—	2.25
10. 7	0.45	1.09	1.31	115.30	11.36	0.09	0.60	16.95	3.54
18. 7	0.56	1.21	1.49	130.81	11.39	0.09	1.21	26.54	4.56
25. 7	0.74	1.30	1.77	154.95	11.42	0.07	2.55	39.66	6.43
1. 8	0.80	1.61	2.39	208.40	11.46	0.06	4.00	45.15	8.86
9. 8	1.00	1.67	2.55	222.19	11.47	0.04	5.40	50.66	10.66
15. 8	1.08	1.98	2.85	248.06	11.48	0.03	7.20	54.79	13.14
22. 8	1.20	2.03	3.20	278.23	11.50	—	8.18	55.23	14.81
29. 8	1.47	2.19	3.25*	282.54	11.50	—	10.09	59.35	17.00
6. 9	1.54*	2.48	3.20	278.23	11.50	—	10.65*	59.60	17.87
12. 9	1.52	2.74*	3.10	269.61	11.49	—	10.55	58.91	17.91*

* Maximum in weight and area values.
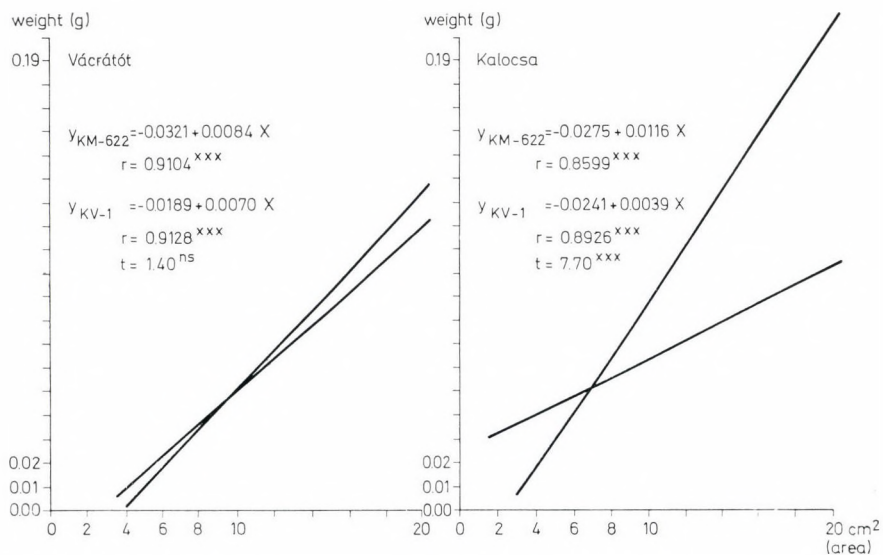
Fig. 2. Relationship between the area and the weight of leaves (r = correlation coefficient, t = significant test of the difference of the regression coefficients)

Table 6

Seasonal changes in the mean value of total plant weights and the weights of certain plant organs, as well as the leaf area, Kalocsa, KV-1 variety

Date of sampling	Root (g)	Stem (g)	Leaves			Flowers (g)	Yields		Total plant weight (g)
			(g)	(cm^2)	mg $(cm^2)^{-1}$		(g)	(%)	
19. 5	0.08	0.15	0.17	37.41	4.54	—	—	—	0.40
5. 6	0.17	0.20	0.24	55.35	4.33	—	—	—	0.61
20. 6	0.24	0.27	0.30	70.74	4.24	—	—	—	0.81
27. 6	0.25	0.32	0.40	96.38	4.15	—	—	—	0.97
4. 7	0.30	0.40	0.44	106.64	4.12	0.02	—	—	1.14
10. 7	0.35	0.50	0.60	147.66	4.06	0.04	—	—	1.49
18. 7	0.40	0.66	0.82	204.07	4.01	0.14	0.38	15.83	2.40
25. 7	0.57	0.70	1.23	309.20	3.97	0.18	0.42	13.55	3.10
1. 8	0.62	0.95	1.50	378.43	3.96	0.25	0.93	22.04	4.22
9. 8	0.75	1.26	1.79	452.79	3.95	0.30	1.52	27.05	5.62
15. 8	0.83	1.42	2.25	570.74	3.94	0.34	2.46	33.70	7.30
22. 8	0.91	1.65	2.40	609.20	3.94	0.30	3.71	41.36	8.97
29. 8	1.05	1.73	2.56	650.23	3.94	0.25	5.50	49.59	11.09
6. 9	1.08	1.85	2.78	706.64	3.93	0.20	6.60	52.76	12.51
12. 9	1.10	1.92	2.88*	732.28	3.93	0.18	8.45	58.16	14.53
19. 9	1.11*	1.95*	2.86	727.15	3.93	0.10	9.90	62.19	15.92
28. 9	1.06	1.90	2.80	711.76	3.93	0.05	10.56*	64.51	16.37*
4. 10	1.02	1.88	2.78	706.64	3.93	0.02	10.14	64.02	15.84

* Maximum in weight and area values.

Weight measurements

The red-pepper individuals were separated by organs dried at 85 °C for 48 hours, then weighed by means of tara or analytical balance. In the calculations, the average values obtained from the measurement results of single or of 5 individuals were used. Only the average values will be demonstrated below.

Growth analysis and the calculation of the characteristics

Growth analysis was elaborated on the basis of a profound study of the gradual accumulation of dry matter production, at the beginning of the century (Blackman 1919, Brigg, Kidd and West 1920, Gregory 1917, 1926). This is a good approximation method, which can be used for following the dynamics of production by the assimilation system. The methodology of growth analysis is described in detail by Květ, Ondok, Nečas and Jarvis (1971) and by Evans (1972). A Hungarian summary of the topic has also been published by Virágh (1980).

Table 7

Seasonal changes in the mean value of total plant weights and the weights of certain plant organs, as well as the leaf area, Vácrátót, KM-622 variety

Date of sampling	Root (g)	Stem (g)	Leaves			Flowers (g)	Yield		Total plant weight (g)
			(g)	(cm^2)	mg $(cm^2)^{-1}$		(g)	(%)	
14. 6	0.12	0.14	0.18	25.25	7.12	—	—	—	0.44
21. 6	0.19	0.20	0.28	37.15	7.53	—	—	—	0.67
29. 6	0.20	0.26	0.40	51.44	7.77	0.02	—	—	0.88
6. 7	0.21	0.39	0.57	71.67	7.95	0.04	0.01	0.83	1.21
14. 7	0.28	0.64	1.09	133.58	8.16	0.08	0.03	1.42	2.12
20. 7	0.31	0.86	1.49	181.20	8.22	0.09	0.10	3.51	2.85
26. 7	0.47	1.46	2.16	260.96	8.27	0.10	0.23	5.22	4.41
2. 8	0.59	1.66	2.77	333.58	8.30	0.10	0.84	14.09	5.96
8. 8	0.69	2.28	3.43	412.15	8.32	0.08	1.93	22.89	8.43
16. 8	0.98	3.28	4.61	552.63	8.34	0.06	3.58	28.57	12.53
24. 8	1.55	4.49	5.79	693.10	8.35	0.04	6.52	35.42	18.41
31. 8	1.80	5.14	5.99*	716.91	8.36	0.02	9.06	41.13	22.03
7. 9	1.84	5.75	5.95	712.15	8.36	0.01	12.12	47.26	25.71
14. 9	1.96*	5.95*	5.80	694.29	8.35	—	15.09	52.38	28.81
21. 9	1.83	5.84	5.38	644.29	8.35	—	16.95*	56.50	30.00
27. 9	1.75	5.47	5.23	626.44	8.35	—	16.42	56.88*	28.87
5. 10	1.66	4.66	4.95	593.10	8.35	—	14.90	55.73	25.46

* Maximum in weight and area values.

Owing to the meaning of growth characteristics, the method of growth analysis is also suitable for a number of ecological, selection and competition studies, apart from the primary aim of determining the photosynthetic production. In this study growth analysis was primarily used for assessing the relationship between crop and growth characteristics as well as the effect of environmental factors on production and growth processes.

Definition of the growth characteristics and their dimensions used in the paper are given in Table 4.

Results

Weight and area changes

The periodical changes in the total weight of one individual, in that of the various plant parts and in the area of all the leaves occurring on one plant are demonstrated in Tables 5—8 and in Figs 3 and 4.

The measurement data on both varieties from both growing areas showed that the periodical changes in the weights and leaf areas show similar tendencies, similar changes. This can be described by growth functions (accumulation and exponential functions, 2nd

Table 8

Seasonal changes in the mean value of total plant weights and the weights of certain plant organs, as well as the leaf area, Vácrátót, KV-1 variety

Date of sampling	Root (g)	Stem (g)	Leaves			Flowers (g)	Yield		Total plant weight (g)
			(g)	(cm²)	mg (cm²)⁻¹		(g)	(%)	
14. 6	0.36	0.19	0.38	56.98	6.66	—	—	—	0.93
21. 6	0.38	0.26	0.41	62.27	6.58	—	—	—	1.05
29. 6	0.40	0.34	0.48	71.27	6.73	0.05	—	—	1.27
6. 7	0.43	0.53	0.59	86.98	6.78	0.07	0.02	1.22	1.64
14. 7	0.48	0.80	0.84	122.70	6.84	0.12	0.06	2.61	2.30
20. 7	0.51	0.96	1.10	159.84	6.88	0.22	0.07	2.45	2.86
26. 7	0.60	1.40	1.49	215.55	6.90	0.24	0.09	2.36	3.82
2. 8	0.71	1.69	1.79	258.41	6.92	0.25	0.21	4.52	4.65
8. 8	0.80	2.92	2.85	409.84	6.95	0.28	0.95	12.18	7.80
16. 8	1.18	4.06	3.53	506.98	6.96	0.32	1.53	14.41	10.62
24. 8	1.87	5.99	5.28	756.98	6.97	0.39	3.17	18.98	16.70
31. 8	2.21	6.88	6.01	861.27	6.97	0.52	4.72	23.21	20.34
7. 9	2.30	7.65	6.28	899.84	6.97	0.37	6.42	27.89	23.02
14. 9	2.42	7.87	6.59	944.12	6.98	0.24	13.17	43.47	30.30
21. 9	2.48	7.92*	6.62	948.41	6.98	0.08	14.38	45.68	31.48
27. 9	2.50	7.72	6.65	952.70	6.98	0.09	14.18	46.06	31.44
5. 10	2.51*	7.65	6.80*	974.12*	6.98	0.02	14.60*	46.23*	31.58*

* Maximum in weight and area values.

degree polynomial). The changes in the weight of all the plant organs examined and the changes in the total plant weight have their exponential phases in shorter or longer vegetation periods (see Table 9). When making a comparison between the varieties in this respect, we describe only the exponential functions of changes in crop weights.

In the crops in both growing areas, the exponential phase was longer in the KV-1 variety than in that of KM-622. This difference presumably indicates that KM-622 is a variety of earlier riping, moreover, that with the KV-1 variety newer flowers and green fruits were growing during almost the whole vegetation period.

The growth rate of the fruit weight is however higher with the KM-622 variety than with the other one. The KM-622 variety brings much more crops than the KV-1 variety. This is indicated beyond the changes in function also by the absolute values of fruit weights related to individuals, as well as by the percentage distribution of these weights related to the total plant weight (see Tables 5—8). With KM-622, also the maximum values of the fruit weights occur earlier than those in the KV-1 variety, and then hardly any changes occur further on.
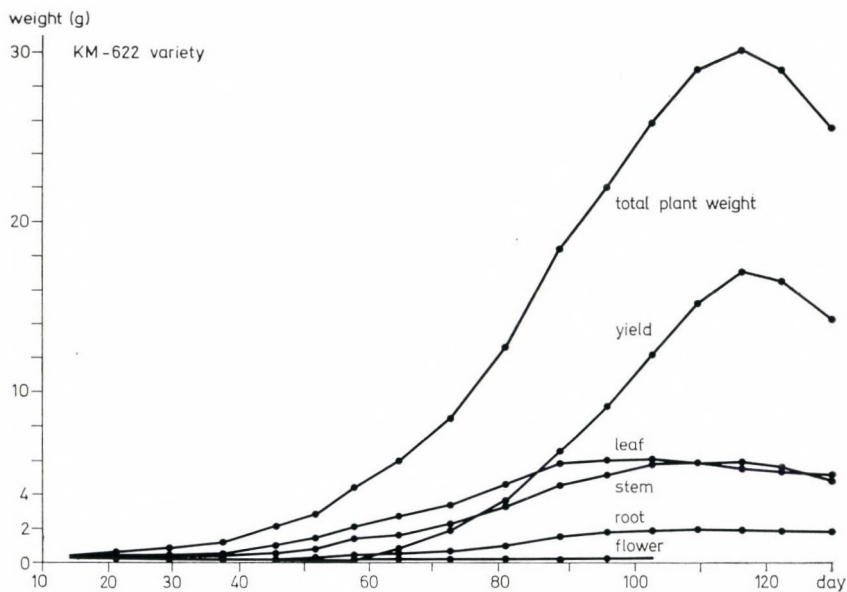
Fig. 3. Seasonal changes in the mean value of the total plant weights and weights of the plant organs of KM-622 variety, in Vácrátót
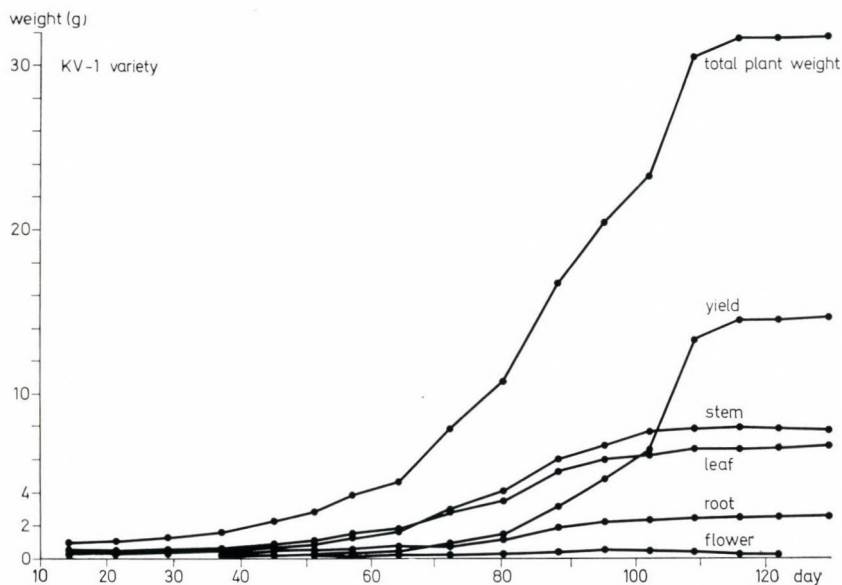
Fig. 4. Seasonal changes in the mean value of the total plant weights and weights of the plant organs of the KV-1 variety in Vácrátót

Growth characteristics

The aim of the growth analyses carried out in pepper varieties was to obtain information on the changes in time of the growth parameters in the two varieties, and to establish the extent of differences in the growth and assimilation rates of the varieties; finally, correlations between growth characteristics and fruit weights were also examined.

Periodical changes

The periodical changes in growth characteristics are demonstrated in Tables 10—13.

It can be stated that the characteristic periodical changes in NAR and in RGR show similar tendencies. (The differences in RGR and NAR values related to the varieties will be discussed later on, but let us mention here that although there are deviations also in the sizes related to the growth characteristics, their periodical changes correspond to each other even in relation to varieties.) The value of LAR increase in spring, parallely with the increase in leaf number and area, then it shows a decrease which can be linked with leaf ageing and with leaf area fully developed and with the more intensive accumulation in weight.

The maximum values of characteristics

When looking at the maximum values of the growth characteristics (see Tables 10—13) it can be realized that the RGR and NAR maxima occur simultaneously, and they are always preceded by the maximum values of LAR. The RGR_{crop} maximum values in general follow one week after the RGR_{total} and NAR maximum values. It should also be noted that the RGR_{crop} maximum values mostly appear 1—2 weeks later than the increase in leaf area and weight.

Comparison between varieties in the experimental area of Vácrátót

Comparing the characteristics related to varieties obtained from the Vácrátót samples NAR values are higher in all periods of vegetation in the KM-622 variety. This indicates a higher efficiency in assimilation. The LAR values are much lower in this variety than in KV-1 in certain periods. In spring, LAR starts from higher values and it reaches a higher maximum, but it's decline in later periods is much more forceful than that in the case of KV-1. This can be a consequence of higher surface areas of the leaves and a greater organic matter accumulation in the case of KM-622.

Similarly to the NAR, the RGR_{total} values, expressing the weight increase of the whole plant, also are always greater in the KM-622 variety, than in KV-1 in the individual sampling periods. This also implies that the changes in the characteristics (RGR) are primarily determined by the NAR and not by the LAR.

In Fig. 5 changes in the specific LA (spec.LA) and in LWR are demonstrated. It can be seen that as a consequence of stronger weight accumulation, taking place in the leaves, the spec. LA value are much smaller in KM-622, whereas the situation is reserved in the case of the LWR characteristic. This may be due to primarily the leaf weights and in the differences occurring in the relationships between leaf weight and the weight of the whole plant.
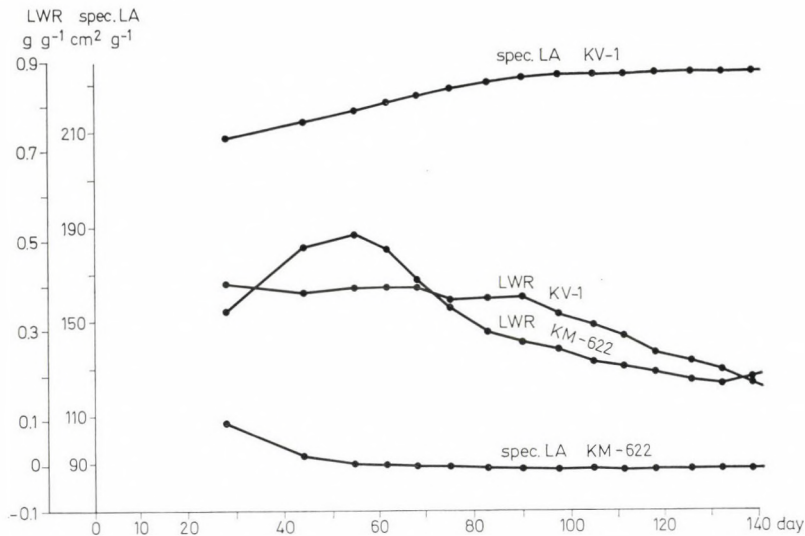
Fig. 5. Seasonal changes of specific LA and LWR values of the *Capsicum* varieties in Kalocsa

Comparison between varieties from the experimental area of Kalocsa

The changes and differences in the growth characteristics found in the varieties from Kalocsa growing area were similar to those at Vácrátót. The difference is merely that the RGR_{total} values are at times higher, at others lower in the two varieties when the periods are compared by pairs and that the spec. LA value -although it is much higher in the KV-1 variety than in the KM-622 -does not decrease with time on the contrary, it increases (see Fig. 6). The RGR_{total} and the NAR characteristics reach their maximum values 2 weeks earlier in the experimental area of Kalocsa than those at Vácrátót. However, the maximum value of these parameters is always higher in the KM-622 variety in Kalocsa.

The "yearly averages" of the growth characteristics

The values characteristic of the vegetation periods in relation to the individual growth parameters are presented in Table 14. From the definitions of the rates it follows that the "yearly averages" could not be determined as the arithmetic mean of the yearly 16—17 data. Therefore, the RGR, NAR, LAR, etc. values characteristic of the whole year were calculated on the basis of the springtime, first leaf area and weight and of the leaf area and dry weight production obtained by the end of the vegetation period.

It is characteristic of the deviations in the yearly averages of the growth parameters related to varieties that the RGR and NAR values calculated for the total weight of the plant and for each of the plant parts are much higher in KM-622 than in KV-1, whereas in the case of LAR the situation is reversed. The differences in the varieties also are much greater in relation to the yearly characteristics occurring in the growing area of Kalocsa than those in Vácrátót. The differences are especially conspicuous with respect to the values of RGR_{crop} and of NAR.

Table 9

Parameters of exponential function of increasing in weight of total plant and plant organs

Variety / Locality	Plant organs	KM-622 sampling period	KM-622 parameters of exponential function ($y = ab^x$)	KM-622 percentage rate of increase in weight	KV-1 sampling period	KV-1 parameters of exponential function ($y = ab^x$)	KV-1 percentage rate of increase in weight
Vácrátót	root	14. 6—24. 8	$a = 0.0751$ $b = 1.0325$	3.25	14. 6—16. 8	$a = 0.2499$ $b = 1.0167$	1.67
	stem	14. 6—24. 8	$a = 0.0714$ $b = 1.0495$	4.95	14. 6—24. 8	$a = 0.0936$ $b = 1.0481$	4.81
	leaves	14. 6—24. 8	$a = 0.1059$ $b = 1.0495$	4.95	14. 6—24. 8	$a = 0.1770$ $b = 1.0380$	3.80
	yield	14. 6—16. 8	$a = 0.00007$ $b = 1.1532$	15.31	6. 7—14. 9	$a = 0.0007$ $b = 1.0957$	9.57
	total plant weight	14. 6—24. 8	$a = 0.2113$ $b = 1.0524$	5.24	14. 6—14. 9	$a = 0.4276$ $b = 1.0404$	4.04
Kalocsa	root	19. 5—15. 8	$a = 0.0502$ $b = 1.0304$	3.04	—	—	—
	stem	19. 5—10. 7	$a = 0.0174$ $b = 1.0593$	5.93	19. 5—22. 8	$a = 0.0756$ $b = 1.0273$	2.73
	leaves	19. 5—22. 8	$a = 0.0946$ $b = 1.0304$	3.4	19. 5—15. 8	$a = 0.0732$ $b = 1.0318$	3.18
	yield	10. 7—15. 8	$a = 0.0054$ $b = 1.0713$	7.13	19. 5— 6. 9	$a = 0.0024$ $b = 1.0651$	6.51
	total plant weight	19. 5—15. 8	$a = 0.0917$ $b = 1.048$	4.98	19. 5— 6. 9	$a = 0.1566$ $b = 1.0351$	3.51

Table 10

Seasonal changes of growth characteristics, Kalocsa, KM-622 variety

Sampling period	RGR_{root}	RGR_{stem}	RGR_{leaf}	RLGR	RGR_{yield}	RGR_{total}	NAR	LAR	spec.LA	LWR
19. 5— 5. 6	0.0587	0.0407	0.0486	0.0384	—	0.0502	0.001339	36.65	106.78*	0.3433
5. 6—20. 6	0.0127	0.0515	0.0869	0.0794	—	0.0554	0.001308	44.76	92.52	0.4839
20. 6—27. 6	0.0175	0.1170	0.0554	0.0534	—	0.0713	0.001549	45.66*	89.45	0.5105*
27. 6— 4. 7	0.0542*	0.0323	0.0268	0.0261	—	0.0334	0.000791	42.24	88.67	0.4764
4. 7—10. 7	0.0281	0.0645*	0.8368*	0.0360*	—	0.0755*	0.002074*	35.95	88.21	0.4076
10. 7—18. 7	0.0273	0.0130	0.0160	0.0157	0.0876	0.0316	0.001037	30.38	87.89	0.3457
18. 7—25. 7	0.0398	0.0102	0.0246	0.0241	0.1064*	0.0490	0.001874	26.00	87.65	0.2966
25. 7— 1. 8	0.0111	0.0305	0.0429*	0.0423*	0.0643	0.0457	0.001925	23.76	87.34	0.2721
1. 8— 9. 8	0.0278	0.0045	0.0081	0.0080	0.0375	0.0231	0.001046	22.04	87.16	0.2531
9. 8—15. 8	0.0128	0.0283	0.0183	0.0183	0.0479	0.0348	0.001760	19.75	87.08	0.2269
15. 8—22. 8	0.0150	0.0035	0.0165	0.0163	0.0182	0.0170	0.000908	28.82	86.99	0.2165
22. 8—29. 8	0.0289	0.0108	0.0022	0.0021	0.0299	0.0197	0.001116	17.62	86.94	0.2028
29. 8— 6. 9	0.0058	0.0155	—0.0019	—0.0019	0.0067	0.0062	0.000388	16.08	86.94	0.1850
6. 9—12. 9	—0.0021	0.0166	—0.0052	—0.0052	—0.0015	0.0003	0.000024	15.31	86.95	0.1761

* Maximum value of growth characteristics.

Table 11

Seasonal changes of growth characteristics, Kalocsa, KV-1 variety

Sampling period	RGR_{root}	RGR_{stem}	RGR_{leaf}	RLGR	RGR_{yield}	RGR_{total}	NAR	LAR	spec.LA	LWR
19. 5— 5. 6	0.0443	0.0169	0.0202	0.0230	—	0.0248	0.000270	91.84	226.24	0.4059
5. 6—20. 6	0.0229	0.0200	0.0148	0.0163	—	0.0189	0.000213	88.79	233.50	0.3803
20. 6—27. 6	0.0058	0.0242	0.0410	0.0441	—	0.0257	0.000276	93.88	238.74	0.3933
27. 6— 4. 7	0.0161	0.0318	0.0136	0.0144	—	0.0230	0.000239	96.21	241.69	0.3981
4. 7—10. 7	0.0371*	0.0371*	0.0516*	0.0542*	—	0.0446	0.000463	96.69*	244.51	0.3954
10. 7—18. 7	0.0166	0.0347	0.0390	0.0404	—	0.0595*	0.000652*	90.41	247.69	0.3650
18. 7—25. 7	0.0505*	0.0084	0.0579*	0.0593*	0.0142	0.0365	0.000395	93.32	250.37	0.3727
25. 7— 1. 8	0.0120	0.0436*	0.0283	0.0288	0.1135	0.044	0.000467	93.93	251.87	0.3730
1. 8— 9. 8	0.0237	0.0353	0.0220	0.0224	0.6114*	0.0358	0.000422	84.47	252.65	0.3343
9. 8—15. 8	0.0168	0.0199	0.0381	0.0385	0.0802	0.0435	0.000550	79.22	253.34	0.3127
15. 8—22. 8	0.0131	0.0214	0.0092	0.0093	0.0586	0.0294	0.000405	72.52	253.75	0.2858
22. 8—29. 8	0.0204	0.0067	0.0092	0.0093	0.0562	0.0303	0.000481	62.78	253.91	0.2473
29. 8— 6. 9	0.0035	0.0083	0.0103	0.0103	0.0227	0.0150	0.000262	57.49	254.09	0.2263
6. 9—12. 9	0.0030	0.0061	0.0058	0.0059	0.0411	0.0249	0.000468	53.21	254.22	0.2093
12. 9—19. 9	0.0012	0.0022	—0.0009	—0.0010	0.0226	0.0130	0.000272	47.92	254.25	0.1885
19. 9—28. 9	—0.0051	—0.0028	—0.0023	—0.0023	0.0071	0.0030	0.000069	44.56	254.22	0.1753
28. 9— 4. 10	—0.0064	—0.0017	—0.0011	—0.0012	—0.0067	—0.0054	—0.000125	44.03	254.19	0.1732

* Maximum value of growth characteristics.

Table 12

Seasonal changes of growth characteristics, Vácrátót, KM-622 variety

Sampling period	RGR_{root}	RGR_{stem}	RGR_{leaf}	RLGR	RGR_{yield}	RGR_{total}	NAR	LAR	spec.LA	LWR
14.6—21. 6	0.0656	0.0509	0.0631	0.0551	—	0.0600	0.001066	56.21	135.65*	0.41
21.6—29. 6	0.0064	0.0327	0.0445	0.0406	—	0.0340	0.000598	57.15	130.28	0.44
29.6— 6. 7	0.0060	0.0506	0.0442	0.0414	—	0.0398	0.000676	58.90*	126.92	0.46
6.7—14. 7	0.0359*	0.0619*	0.0810*	0.0778*	0.1373	0.0700*	0.001144*	61.63	123.64	0.50
14.7—20. 7	0.0169	0.0492	0.0521	0.0508	0.2006*	0.0493	0.000779	63.33*	122.01	0.52*
20.7—26. 7	0.0693*	0.0882*	0.0618*	0.0607*	0.1388	0.0727*	0.001189*	60.90	121.14	0.50
26.7— 2. 8	0.0324	0.0183	0.0355	0.0350	0.1850*	0.0430	0.000749	57.33	120.60	0.48
2.8— 8. 8	0.0195	0.0396	0.0267	0.0263	0.1039	0.0433	0.000831	51.82	120.28	0.43
8.8—16. 8	0.0438	0.0454	0.0369	0.0366	0.0772	0.0495	0.001077	46.02	120.00	0.38
16.8—24. 8	0.0573	0.0392	0.0284	0.0283	0.0749	0.0480	0.001185*	40.26	119.78	0.34
24.8—31. 8	0.0213	0.0193	0.0048	0.0048	0.0469	0.0256	0.000734	34.86	119.70	0.29
31.8— 7. 9	0.0031	0.0160	—0.0009	—0.0009	0.0419	0.0220	0.000736	29.93	119.69	0.25
7.9—14. 9	0.0090	0.0048	—0.0036	—0.0036	0.0309	0.0162	0.000630	25.79	119.70	0.22
14.9—21. 9	—0.0098	—0.0026	—0.0107	—0.0106	0.0166	0.0057	0.000254	22.76	119.73	0.19
21.9—27. 9	—0.0074	—0.0109	—0.0047	—0.0046	—0.0052	—0.0063	—0.000269	21.58	119.76	0.18
27.9— 5.10	—0.0066	—0.0200	—0.0068	—0.0068	—0.0182	—0.0157	—0.000699	22.44	119.80	0.19

* Maximum value of growth characteristics.

Table 13

Seasonal changes of growth characteristics, Vácrátót, KV-1 variety

Sampling period	RGR_{root}	RGR_{stem}	RGR_{leaf}	RLGR	RGR_{yield}	RGR_{total}	NAR	LAR	spec.LA	LWR
14. 6—21. 6	0.0077	0.0448	0.0109	0.0127	—	0.0173	0.000288	60.22*	150.94*	0.3989*
21. 6—29. 6	0.0064	0.0335	0.0197	0.0169	—	0.0238	0.000412	57.56*	150.04	0.3836
29. 6— 6. 7	0.0090	0.0555	0.0258	0.0249	—	0.0320	0.000586	54.38	147.89	0.3676
6. 7—14. 7	0.0138	0.0515	0.0442	0.0430	0.1373	0.0423	0.000795	53.21	146.62	0.3629
14. 7—20. 7	0.0101	0.0304	0.0449	0.0441	0.0257	0.0363	0.000665	54.75	145.63	0.3759
20. 7—26. 7	0.0271	0.0629*	0.0506*	0.0498*	0.0419	0.0482	0.000859	56.19*	144.93	0.3877
26. 7— 2. 8	0.0240	0.0269	0.0262	0.0259	0.1210	0.0281	0.000502	55.95	144.50	0.3872
2. 8— 8. 8	0.0149	0.0684*	0.0581*	0.0577*	0.1887*	0.0647*	0.001199*	53.67	144.01	0.3726
8. 8—16. 8	0.0486	0.0412	0.0267	0.0266	0.0596	0.0386	0.000772	49.77	143.70	0.3463
16. 8—24. 8	0.0576*	0.0486	0.0503*	0.0501*	0.0911	0.0566*	0.001219*	46.26	143.46	0.3224
24. 8—31. 8	0.0239	0.0198	0.0185	0.0184	0.0569	0.0282	0.000644	43.68	143.33	0.3048
31. 8— 7. 9	0.0057	0.0152	0.0063	0.0063	0.0439	0.0177	0.000435	40.61	143.29	0.2834
7. 9—14. 9	0.0073	0.0041	0.0069	0.0069	0.1026	0.0393	0.001128	34.58	143.27	0.2413
14. 9—21. 9	0.0035	0.0009	0.0006	0.0006	0.0126	0.0055	0.000178	30.63	143.26	0.2138
21. 9—27. 9	0.0013	—0.0043	0.0008	0.0008	0.0012	—0.0002	—0.000007	30.21	143.26	0.2109
27. 9— 5. 10	0.0005	—0.0011	0.0028	0.0028	0.0010	0.0006	0.000018	30.57	143.25	0.2134

* Maximum value of growth characteristics.

Table 14

"Annual mean" of growth characteristics

Locality / Variety	RGR_{root}	RGR_{stem}	RGR_{leaf}	RLGR	RGR_{yield}
Vácrátót					
KM-622	0.0294	0.0395	0.0433	0.0413	0.0941
KV-1	0.0167	0.0333	0.0248	0.0244	0.0708
Kalocsa					
KM-622	0.0281	0.0329	0.0376	0.0344	0.1089
KV-1	0.0213	0.0208	0.0243	0.0256	0.0461

Locality / Variety	RGR_{total}	NAR	LAR	mg cm^{-2}
Vácrátót				
KM-622	0.0414	0.001516	21.99	8.1435
KV-1	0.0303	0.000818	31.71	6.8863
Kalocsa				
KM-622	0.0387	0.002027	15.25	11.0900
KV-1	0.0281	0.000529	44.67	4.0450
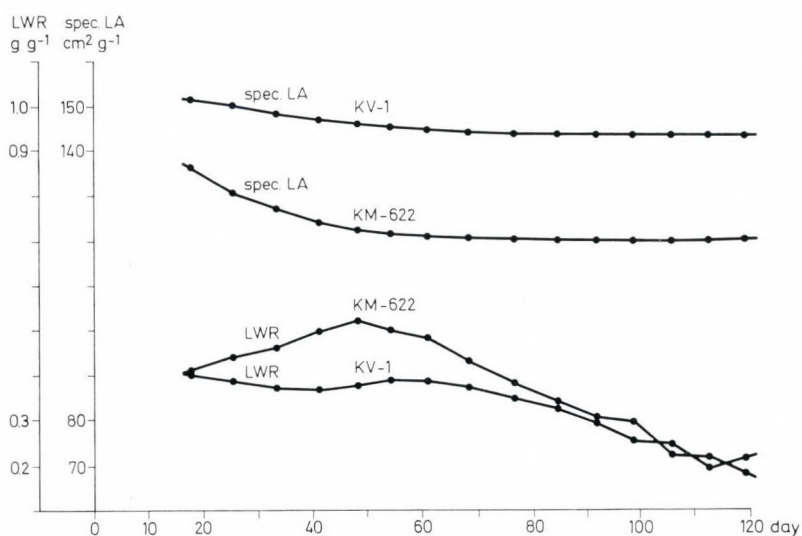
Fig. 6. Seasonal changes of specific LA and LWR values of the *Capsicum* varieties in Vácrátót
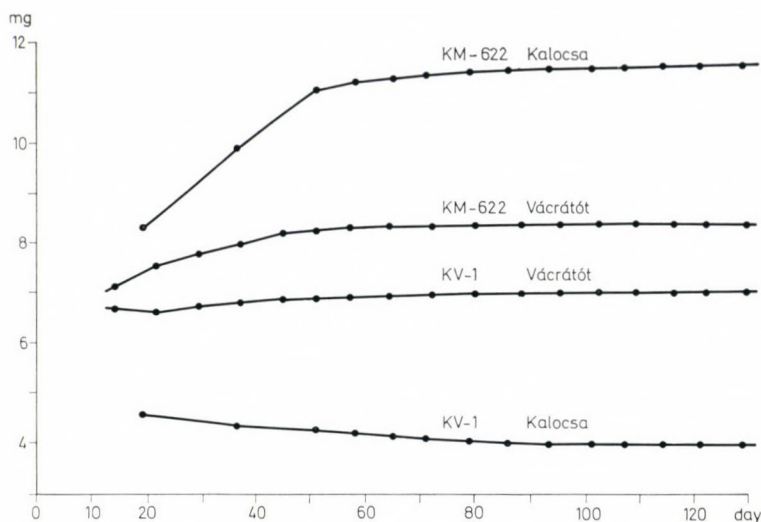
Fig. 7. Changes in weight of unit leaf areas (1 cm^2) of the investigated *Capsicum* varieties

On the basis of the changes in growth characteristics it should be emphasized that in KM-622 — in both growing areas — the values of NAR are higher and those of spec. LA are lower during the whole vegetation period. The maximum values, and also the "annual averages" of these characteristics are higher and lower in this variety. Following from this a greater efficiency in assimilation can be supposed in the KM-622 variety, and it can be also considered as more efficient in organic matter production. This has already been referred to when the correlation between leaf area and weight was analysed. Our supposition is supported by the changes in weights calculated for a unit of leaf area by periods (Tables 5—8, Fig. 7). Consistently the KM-622 gave higher values. The differences between varieties are remarkably high also in this respect in the growing area of Kalocsa.

Correlations between the growth characteristics

The correlations occurring between the growth characteristics previously discussed will be described below (see Table 15).

The closest correlation occurs between RGR_{total} and NAR, and RGR_{total} and RLGR, in both varieties and in both growing areas. A likewise close correlation occurs between RGR and LAR, but only in KM-622. The correlation between spec. LA and LWR is close only in KV-1; no significant relationship occurs between them in KM-622.

The differences in the varieties are remarkable in relation also to the RGR_{crop} and the other growth characteristics (see Table 15). In KM-622, the closest correlation occurs between RGR_{crop} and LAR, with respect to all the correlations. Essentially it should be emphasized that the correlation between RGR_{crop} and LAR and RGR_{total} is always closer than the correlation between RGR_{crop} and NAR. The RGR_{crop} values are in closer with RGR_{stem} values than with RGR_{leaf} and with RLGR. In KV-1 this is of a reversed case. In this variety, the relationship between RGR_{crop} and LAR is weak, in contrast with KM-622.

Table 15

Correlation coefficients between growth characteristics

Locality / Variety	Kalocsa		Vácrátót	
	KM-622	KV-1	KM-622	KV-1
RGR_{total} — NAR	0.8214***	0.9256***	0.9130***	0.7461***
RGR_{total} — LAR	0.7802***	0.6988**	0.8705***	0.2601^{ns}
RGR_{total} — RLGR	0.8093***	0.7405**	0.9136***	0.8901***
NAR — LAR	0.3545^{ns}	0.4617^{+}	0.6690**	0.3608^{ns}
spec.LA — LWR	0.3019^{ns}	—0.7015**	0.4110^{ns}	0.6428**
RGR_{yield} — RGR_{total}	0.9031***	0.8299**	0.8220***	0.7580**
RGR_{yield} — NAR	0.7642*	0.7687**	0.6635*	0.7354**
RGR_{yield} — LAR	0.9105***	0.6707*	0.9531***	0.5662*
RGR_{yield} — RLGR	0.6811*	0.3528^{ns}	0.8355***	0.5988*
RGR_{yield} — RGR_{leaf}	0.6834*	0.3563^{ns}	0.8325***	0.5974*
RGR_{yield} — RGR_{stem}	0.1143^{ns}	0.8699***	0.7361**	0.6434*

*** Significant at 0.001 probability level.
** Significant at 0.01 probability level.
* Significant at 0.05 probability level.
$^{+}$ Significant at 0.10 probability level.
^{ns} No significant value.

The correlations between crop weight and growth indices have been studied (see Table 16). It can be seen that all the correlations are negative. This however is easily understandable if we consider that the crop weights gradually increase, whereas the growth rate

Table 16

Correlation coefficients between yield weights and growth characteristics

Locality / Variety	Kalocsa		Vácrátót	
	KM-622	KV-1	KM-622	KV-1
W_{yield} — RGR_{total}	—0.8496**	—0.9008***	—0.8827***	—0.7237**
W_{yield} — NAR	—0.7169**	—0.7419**	—0.6874**	—0.5531*
W_{yield} — LAR	—0.9517***	—0.9892***	—0.9837***	—0.8231***
W_{yield} — RLGR	—0.7681**	—0.8752***	—0.9170***	—0.8231***
W_{yield} — RGR_{leaf}	—0.7700**	—0.8733***	—0.9151***	—0.7513**
W_{yield} — RGR_{stem}	$—0.4547^{ns}$	$—0.5717^{+}$	—0.8575***	—0.8007***

*** Significant at 0.001 probability level.
** Significant at 0.01 probability level.
* Significant at 0.05 probability level.
$^{+}$ Significant at 0.10 probability level.
^{ns} No significant value.

Table 17

Daily mean of meteorological data in the sampling periods, Kalocsa

Sampling period	Total precipitation (mm)	Temperature maximum	Temperature minimum	Mean temperature	Radiation minimum
		(°C)			
19. 5— 5. 6	0.85	22.95	11.47	17.28	10.16
5. 6—20. 6	3.02	22.91	12.80	17.84	11.48
20. 6—27. 6	1.73	23.86	11.46	17.63	9.63
27. 6— 4. 7	3.21	22.81	12.63	17.71	10.80
4. 7—10. 7	4.65	23.13	12.42	17.77	10.88
10. 7—18. 7	0.25	25.47	13.28	19.51	11.98
18. 7—25. 7	3.26	21.76	13.31	16.60	10.43
25. 7— 1. 8	—	28.51	13.79	21.14	12.37
1. 8— 9. 8	0.51	29.03	15.53	22.28	15.53
9. 8—15. 8	0.28	23.20	12.25	17.70	10.80
15. 8—22. 8	0.59	25.00	11.01	18.00	9.44
22. 8—29. 8	0.20	23.46	10.20	16.81	8.51
29. 8— 6. 9	2.65	20.63	20.25	15.35	8.43
6. 9—12. 9	0.20	21.67	13.28	17.47	11.73
12. 9—19. 9	0.13	46.34	8.31	14.34	6.39
19. 9—28. 9	0.93	19.66	9.68	14.72	8.18
28. 9— 4. 10	1.00	19.63	10.65	15.13	9.62

constantly decrease in time. It is conspicuous that the crop weight (W_{crop}) shows a very high negative correlation with RGR_{total}, LAR, RLGR, RGR_{leaf} and with RGR_{stem}, whereas with NAR — in comparison with the others — the negative correlation values were always lower. It should be also emphasized that in the case of KM-622 from Kalocsa, W_{crop} was in the closest negative correlation with LAR. In comparison with the other characteristics the negative correlation between NAR and W_{crop} and RGR_{crop} is not at all close. This can also mean that assimilation has no direct influence on the formation of crop yield, and it is felt only indirectly, through the weight increase of other organs, through translocation.

Correlation analysis between the growth characteristics calculated, and W_{crop} and some meteorological factors (correlations, path-analysis)

In the correlation analysis, of the meteorological factors the mean temperature, the absolute temperature maximum and minimum, the amount of precipitation, the radiation minimum, and in relation to Vácrátót the hours of sunshine were drawn into the calculations. With respect to the environmental factors mentioned, the changes in the absolute values of daily averages between two sampling periods were used in the calculations (see Tables 17—18). Since these meteorological factors were not measured in the stand in any of the areas, the results must be treated with caution. The correlation coefficients related to growth characteristics, crop weight and meteorological factors are demonstrated in Tables 19 and 20.

Table 18

Daily mean of meteorological data in the sampling periods, Vácrátót

Sampling period	Total precipitation (mm)	Temperature maximum (°C)	Temperature minimum (°C)	Mean temperature (°C)	Radiation minimum (°C)	Number of sunny hours
14. 6—21. 6	0.31	21.82	9.53	17.65	8.75	10.22
21. 6—29. 6	4.46	21.35	11.45	17.31	10.42	9.65
29. 6— 6. 7	3.12	21.10	11.37	17.07	10.32	9.11
6. 7—14. 7	2.37	21.45	12.07	17.72	10.91	8.56
14. 7—20. 7	2.06	21.66	12.50	17.98	10.91	7.18
20. 7—26. 7	0.81	21.96	11.06	17.63	9.03	11.06
26. 7— 2. 8	1.78	22.82	15.17	22.51	12.32	12.61
2. 8— 8. 8	3.66	26.95	15.66	22.08	14.15	9.81
8. 8—16. 8	0.58	21.72	11.77	17.23	9.25	7.81
16. 8—24. 8	0.86	23.93	12.23	18.50	9.23	8.97
24. 8—31. 8	1.00	19.85	9.95	15.28	7.51	9.65
31. 8— 7. 9	—	19.95	9.40	15.25	6.80	6.80
7. 9—14. 9	0.04	20.75	10.88	15.84	9.64	7.84
14. 9—21. 9	—	18.40	8.30	11.57	6.35	8.64
21. 9—27. 9	—	20.18	11.01	15.58	9.20	6.00
27. 9— 5. 10	4.61	17.58	9.72	13.33	9.15	4.48

Comparison between varieties ("r") in the experimental area of Kalocsa

With respect to the correlations between growth characteristics and crop weights of the varieties and environmental factors it can be stated that there is hardly any correlation between them which would indicate a close relationship.

In variety KM-622, it was only the crop weight and the crop RGR that showed negative resp. positive correlations acceptable at a 5% level of significance with the precipitation values. In variety KV-1, the crop weight and the crop RGR values, the NAR, LAR and the LWR growth characteristics only showed a relatively strong correlation with the mean temperature, and a slight correlation with the radiation minimum. It should be emphasized that the mean temperature and the radiation minimum systematically always immediately shows a correlation with the parameters examined, whereas the precipitations only about two weeks later. (In the Table, columns "*p*" indicate the results of correlation analyses related to identical periods, wheras columns "*q*" in the case of precipitation values indicate those related to periods shifted by two weeks.) This may represent the fact that temperature has its effect directly in time, whereas precipitation affects later. This has also been found in the varieties grown in the experimental area of Vácrátót.

It is quite striking that the correlation between crop weights and meteorological factors is always negative, in both varieties, and is so not only in the growing area of Kalocsa but also of Vácrátót. From these data it is difficult to explain this phenomenon. It seems however probable that the supposition is right according to which not all the environmental

Table 19

Correlation coefficients between yield weights and growth characteristics, as well as meteorological data, Kalocsa

		Total precipitation		Temperature maximum	Temperature minimum	Mean temperature	Radiation minimum
				(°C)			
		p	q	p	p	p	p
W_{yield}	v	−0.4919	−0.6927*	−0.2477	−0.0542	−0.3321	−0.3553
	z	−0.0834	−0.4229	0.0483	−0.5092+	−0.7720**	−0.6450*
RGR_{yield}	v	0.2445	0.7123*	0.2358	0.3631	0.2431	0.2207
	z	−0.5241+	−0.2167	0.1648	−0.0645	0.7764**	0.5072+
RGR_{total}	v	0.5043+	0.3540	0.0632	−0.1337	0.0642	0.0192
	z	−0.0228	0.3350	0.1694	0.2577	0.7026**	0.5377*
NAR	v	0.2493	0.1375	0.2637	−0.0051	0.2059	0.0730
	z	−0.1840	−0.3777	0.1694	0.2029	0.5803*	0.3976
LAR	v	0.5211+	0.3751	−0.0610	−0.2516	−0.0044	0.0274
	z	0.4112	0.3008	−0.1019	0.3008	0.6530**	0.5527*
Spec. LA	v	0.0113	0.1126	−0.1469	−0.2259	−0.1397	−0.0944
	z	−0.3758	0.0214	0.1582	0.0853	−0.1232	−0.1382
LWR	v	0.5533*	0.3777	−0.0357	−0.2276	0.0230	0.0475
	z	0.4267+	0.4746+	−0.1158	0.2567	0.6050**	0.5167*
RLGR	v	0.3716	0.0923	0.0823	−0.2196	0.0985	0.0587
	z	0.4235+	0.4414+	−0.1482	0.4733+	0.4124+	0.3829
Precipitation		—					
Temperature maximum		−0.3405		—			
Temperature minimum		0.4218		−0.2983	—		
Mean temperature		−0.1544		0.0247	0.1754	—	
Radiation minimum		−0.0042		−0.1854	0.3057	0.8956***	—

v: KM-622; *z*: KV-1; *p* and *q*: see in the text.

factors affect the crop formation, on the increase of crop weights directly, but through other ways they influence the translocation into the crop, through photosynthesis and through the organic matter accumulation in the leaf.

Comparison between varieties ("r") in the growing area of Vácrátót

In the varieties cultivated at Vácrátót, the tremendous number of close, reliable correlations between the external factors and the growth characteristics is remarkable. It is supposed that in the growth area ideal for pepper growing, in the region of Kalocsa, there is no relationship between the external factors examined and the growth characteristics.

In the growth area of Vácrátót, where the unfavourable weather and soil properties are most inappropriate for pepper growing, the meteorological factors were however much

Table 20

Correlation coefficients between yield weights and growth characteristics, as well as meteorological data, Vácrátót

		Total precipitation		Temperature maximum	Temperature minimum	Mean temperature	Radiation minimum	Number of sunny hours
				(°C)				
		p	q	p	p	p	p	p
W_{yield}	v	—0.2962	—0.7800***	—0.6242*	—0.6683**	—0.7429**	—0.6304*	—0.5987*
	z	—0.2499	—0.7542**	—0.6534*	—0.6224*	—0.7376**	—0.5144*	—0.6430*
RGR_{yield}	v	0.1818	0.6163*	0.5645*	0.6690*	0.7359**	0.6230*	0.6230*
	z	0.2858	0.3960	0.7943**	0.7550**	0.7581**	0.7253**	0.5571*
RGR_{total}	v	—0.0224	0.7874***	0.6151*	0.4042	0.6213**	0.3536	0.6696**
	z	—0.0819	0.3929	0.5669*	0.3495	0.2969	0.2359	0.4697+
NAR	v	—0.2476	0.6939**	0.6148*	0.3147	0.5378*	0.1780	0.6809**
	z	—0.0312	0.5386*	0.7168**	0.5288*	0.5344*	0.4202	0.3784
LAR	v	0.3486	0.6472*	0.5609*	0.5304*	0.6875**	0.5745*	0.6197*
	z	0.2878	0.6081*	0.6235**	0.5041*	0.7270**	0.5205*	0.7020**
Spec.LA	v	0.2189	0.2075	0.0823	—0.1330	0.1368	0.0850	0.2908
	z	0.3254	0.3748	0.1394	—0.0165	0.2231	0.1985	0.3427
LWR	v	0.3442	0.6670**	0.5897*	0.5905*	0.7201**	0.6068*	0.6219**
	z	0.2763	0.6098*	0.6506**	0.5396*	0.7529***	0.5360*	0.7140**
RLGR	v	0.2283	0.7909***	0.4751+	0.3936	0.5686*	0.4521+	0.5125*
	z	0.2481	0.7065**	0.7949***	0.6870**	0.7025**	0.6080*	0.4419+
Precipitation		—						
Temperature maximum		—0.1453		—				
Temperature minimum		0.3736		0.8242***	—			
Mean temperature		0.2458		0.8857***	0.9186***	—		
Radiation minimum		0.5772*		0.7401***	0.9239***	0.8378***	—	
Sunny hours		—0.0627		0.5521*	0.4414+	0.6298**	0.3175	—

v: KM-622; *z*: KV-1; *p* and *q*: see in the text.

more manifested than at Kalocsa. Strong positive correlations occur between growth characteristics and external factors, and while concerning crop weights strong negative correlations occur.

In the growth area of Vácrátót, the strong positive correlations between mean temperature and growth characteristics are identical in the varieties. The temperature maximum and minimum values however indicated better correlations in the KV-1 variety, and the precipitation values did so in the KM-622 variety. In both varieties the temperature factors are in a strong positive correlation primarily with the LWR and RLGR characteristics. In relation to the RGR, NAR and LAR characteristics however, it was always LAR where compared to the other two characteristics, the correlation values obtained were higher.

The results of the path analysis

It should be noted that correlation analyses based on correlation coefficients always expressed only the closeness of the relationship between two variables and nothing was expressed about the "cause" of the correlations.

Path analysis is suitable for pointing out such links that are not reciprocal but causal, uni-directional. By means of path coefficients the correlation coefficients can be desaggregated into their components, and it can be determined to what extent the individual influencing factors, the causes determine directly and indirectly the variance of the variable examined. (Path coefficients have their directions and can have positive and negative values or such that are smaller or greater than 1. They are numbers with no dimension. — O'Sváth 1968.)

The theoretical bases of path analysis are described in the works — among others — by Wright (1921, 1954, 1960); Li (1955); Ferrari (1963, 1965); Kempthorne (1957); Le Roy (1960); O'Sváth (1961, 1968) and Précsényi (1974, 1979).

The path diagrams of the correlation systems constructed by us are demonstrated in Fig. 8. In one of the system RGR is the depending variable, while in the other the crop weight.

In Table 21, all the effects directed towards NAR, LAR. RGR and the crop weight are demonstrated as well as the possible direct and indirect effects in the line of the path chains given. These virtually constitute the linear equation systems serving to estimate the path coefficients (Le Roy 1960).

The partitioning of correlation coefficients between two variables, as well as the size of the direct and indirect effects are demonstrated in Tables 22—25, while the value of path coefficients between two variables in Table 26.

The extent of sharing of an independent variable expressed in percentage for example in the "*y*" variance, the depending variable, has been calculated by means of the square of the correlation coefficients, that is the determination coefficients. In this case, the square of the path coefficients expressed by
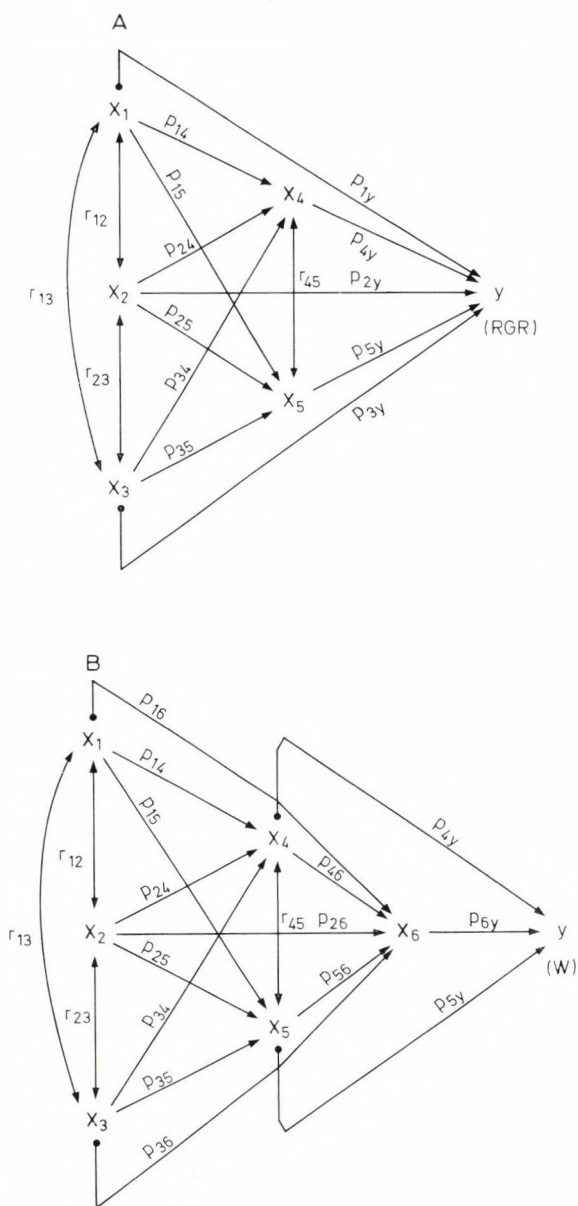
Fig. 8. Path-diagrams forming the basis of path analyses. A: dependent variable = RGR; B: dependent variable: yield weight (W); — x_1: total precipitation; x_2: mean temperature; x_3: radiation minimum; x_4: NAR; x_5: LAR; x_6: RGR)

Table 21

Partition of correlation coefficients

A

$y = \text{RGR}$

$r_{14} = p_{14} + p_{15}r_{45} + p_{24}r_{12} + p_{34}r_{13}$
$r_{24} = p_{24} + p_{25}r_{45} + p_{14}r_{12} + p_{34}r_{23}$
$r_{34} = p_{34} + p_{35}r_{45} + p_{24}r_{23} + p_{14}r_{13}$
$r_{15} = p_{15} + p_{14}r_{45} + p_{25}r_{12} + p_{35}r_{13}$
$r_{25} = p_{25} + p_{24}r_{45} + p_{15}r_{12} + p_{35}r_{23}$
$r_{35} = p_{35} + p_{34}r_{45} + p_{25}r_{23} + p_{15}r_{13}$

$$r_{1y} = p_{1y} + r_{12}p_{2y} + r_{13}p_{3y} + (p_{14} + p_{15}r_{45} + p_{24}r_{12} + p_{34}r_{13})p_{4y} + + (p_{15} + p_{14}r_{45} + p_{25}r_{12} + p_{35}r_{13})p_{5y}$$
$$r_{2y} = p_{2y} + r_{12}p_{1y} + r_{23}p_{3y} + (p_{24} + p_{25}r_{45} + p_{14}r_{12} + p_{34}r_{23})p_{4y} + + (p_{25} + p_{24}r_{45} + p_{15}r_{12} + p_{35}r_{2}{}^{3})p_{5y}$$
$$r_{3y} = p_{3y} + r_{13}p_{1y} + r_{23}p_{2y} + (p_{34} + p_{35}r_{45} + p_{24}r_{23} + p_{14}r_{13})p_{4y} + + (p_{35} + p_{34}r_{45} + p_{25}r_{23} + p_{15}r_{23})p_{5y}$$
$$r_{4y} = p_{4y} + r_{45}p_{5y}$$
$$r_{5y} = p_{5y} + r_{45}p_{4y}$$

B

$y = \text{W (yield weight)}$

$$r_{4y} = p_{4y} + r_{45}p_{5y} + (p_{46} + r_{45}p_{56})p_{6y}$$
$$r_{5y} = p_{5y} + r_{45}p_{4y} + (p_{56} + r_{45}p_{46})p_{6y}$$
$$r_{6y} = p_{6y}$$

relative proportion of the "y" variance which can be attributed to the direct effect of the variable given. The indirect effects were given by the rest of the square members, while the common effects were given together by the twofold multiplications (see Tables 27—31).

The all-effects of every variable that is the quantitative relationships determining the variance of the dependent variable were calculated by means of the square of the multi-correlation coefficient, that is by the multi-determination coefficient. The multi-correlation coefficient equals by definition to the following equation (KEMPTHORNE 1957; LE ROY 1960):

$$R_{y_{1,2,\ldots N}} = \sqrt{1 - e^2} = \sqrt{\sum_{i=1}^{N} (b_i'')^2 + 2 \sum_{\substack{i, \\ i \neq j}}^{N} (b_i'')(b_j'')\, r_{ij}}$$

where b'' = standardized partial regression coefficient = path coefficients,
e^2 = the effect of other factors.
(For its partitioning see Table 32.)

Table 22

Partition of correlation coefficients (meteorological factors — NAR)

Variety \ Locality			Vácrátót		Kalocsa	
			KM-622	KV-1	KM-622	KV-1
Independent variable	effect	$p_j r_{ji}$				
x_1	direct	p_{14}	—1.6637	—0.1631	0.0753	0.4393
	indirect	$p_{15}r_{45}$	1.0541	0.0401	0.1869	0.3116
		$p_{24}r_{12}$	0.2947	0.1420	—0.0126	—0.0564
		$p_{34}r_{13}$	0.0673	—0.0502	—0.0003	0.0001
	total (r_{14})		—0.2476	—0.0312	0.2493	—0.1840
x_2	direct	p_{24}	1.1991	0.5775	0.0816	0.3650
	indirect	$p_{25}r_{45}$	—0.3501	0.0699	0.0764	0.1788
		$p_{14}r_{12}$	—0.4089	—0.0401	—0.0116	0.0678
		$p_{34}r_{23}$	0.0977	—0.0729	0.0595	—0.0313
	total (r_{24})		0.5378	0.5344	0.2059	0.5803
x_3	direct	p_{34}	0.1167	—0.0870	0.0665	—0.0350
	indirect	$p_{35}r_{45}$	0.0170	0.1174	—0.0663	0.1038
		$p_{24}r_{23}$	1.0046	0.4838	0.0731	0.3269
		$p_{14}r_{13}$	—0.9603	—0.0941	—0.0003	0.0019
	total (r_{34})		0.1780	0.4202	0.0730	0.3976

x_1—x_3: see in the Fig. 8.

Comparison between varieties

The effect of growth characteristics on the variability of RGR

It has been stated that in both varieties NAR has the greatest direct effect on RGR.

In KM-622, not only NAR but also LAR has a quite high direct effect, and an indirect one through NAR, on RGR.

In KV-1, in comparison with the former variety, the direct effect of NAR on RGR is much greater, while the direct effect of LAR is much less or insignificant.

Table 23

Partition of correlation coefficients (meteorological factors — LAR)

Variety / Locality			Vácrátót		Kalocsa	
			KM-622	KV-1	KM-622	KV-1
Independent variable	effect	$p_j r_{ji}$				
x_1	direct	p_{15}	1.5756	0.1111	0.5271	0.6748
	indirect	$p_{14}r_{45}$	—1.1130	—0.0588	0.0266	—0.2028
		$p_{25}r_{12}$	—0.1286	0.0476	—0.0333	—0.0598
		$p_{35}r_{13}$	0.0146	0.1879	0.0007	—0.0008
	total (r_{15})		0.3486	0.2878	0.5211	0.4112
x_2	direct	p_{25}	—0.5233	0.1936	0.2154	0.3873
	indirect	$p_{24}r_{45}$	0.8022	0.2084	0.0289	0.1685
		$p_{15}r_{12}$	0.3873	0.0273	—0.0814	—0.1042
		$p_{35}r_{23}$	0.0213	0.2727	—0.1673	0.2014
	total (r_{25})		0.6875	0.7020	—0.0044	0.6530
x_3	direct	p_{35}	0.0255	0.3255	—0.1869	0.2249
	indirect	$p_{34}r_{45}$	0.0780	—0.0313	0.0236	—0.0162
		$p_{25}r_{23}$	—0.4384	0.1622	0.1929	0.3468
		$p_{15}r_{13}$	0.9094	0.0641	—0.0022	—0.0028
	total (r_{35})		0.5745	0.5205	0.0274	0.5527

x_1—x_3: see in the Fig. 8.

The effect of meteorological factors on the variability of RGR

When considering the meteorological factors we stated with both varieties that it is only the indirect effect that is significant in the relationship between external factors and RGR.

The variance of NAR is to a great extent influenced by the mean temperature which has an almost exclusively direct effect. The radiation minimum influences the variance of NAR through the mean temperature and this influence is of a considerable extent. Precipitation influences NAR mainly through LAR.

In relation to LAR, of the 3 meteorological factors the direct effect of precipitation values is strikingly high.

Table 24

Partition of correlation coefficients
(all factors — RGR)

Variety / Independent variable	effect	$p_j r_{ji}$	Vácrátót KM-622	Vácrátót KV-1	Kalocsa KM-622	Kalocsa KV-1
x_1	direct	p_{1y}	—0.0595	—0.0851	0.0426	—0.0311
	indirect	$p_{2y}r_{12}$	—0.0153	—0.0453	0.0140	0.0078
		$p_{3y}r_{13}$	0.0367	0.0749	—0.0002	—0.0004
		$p_{4y}r_{14}$	—0.1481	—0.0234	0.1553	—0.1410
		$p_{5y}r_{15}$	0.1638	—0.0030	0.2915	0.1419
	total (r_{1y})		—0.0224	—0.0819	0.5032	—0.0228
x_2	direct	p_{2y}	—0.0625	—0.1843	—0.0908	—0.0504
	indirect	$p_{1y}r_{12}$	—0.0146	—0.0209	—0.0066	0.0048
		$p_{3y}r_{23}$	0.0533	0.1087	0.0357	0.0782
		$p_{4y}r_{24}$	0.3219	0.4007	0.1283	0.4447
		$p_{5y}r_{25}$	0.3232	—0.0073	—0.0024	0.2253
	total (r_{2y})		0.6213	0.2969	0.0642	—0.7026
x_3	direct	p_{3y}	0.0637	0.1298	0.0399	0.0873
	indirect	$p_{1y}r_{13}$	—0.0343	—0.0491	—0.0002	0.0001
		$p_{2y}r_{23}$	—0.0524	—0.1544	—0.0813	—0.0451
		$p_{4y}r_{34}$	0.1065	0.3151	0.0455	0.3047
		$p_{5y}r_{35}$	0.2701	—0.0055	0.0153	0.1907
	total (r_{3y})		0.3536	0.2359	0.0192	0.5377
x_4	direct	p_{4y}	0.5985	0.7499	0.6231	0.7663
	indirect	$p_{5y}r_{45}$	0.3145	0.0038	0.1983	0.1593
	total (r_{4y})		0.9130	0.7461	0.8214	0.9256
x_5	direct	p_{5y}	0.4701	—0.0105	0.5593	0.3450
	indirect	$p_{4y}r_{45}$	0.4004	0.2706	0.2209	0.3538
	total (r_{5y})		0.8705	0.2601	0.7802	0.6988

x_1—x_5: see in the Fig. 8.

Table 25

Partition of correlation coefficients
(RGR, NAR, LAR — yield weight (W))

Variety \ Locality			Vácrátót		Kalocsa	
			KM-622	KV-1	KM-622	KV-1
Independent variable	effect	$p_j r_{ji}$				
x_4	direct	p_{4y}	0.4753	0.3150	0.0953	0.3279
	indirect	$p_{5y}r_{45}$	—0.3568	—0.3281	—0.1144	—0.2360
		$p_{6y}r_{46}$	—0.8059	—0.5400	—0.6978	—0.8338
	total (r_{4y})		—0.6874	—0.5531	—0.7169	—0.7119
x_5	direct	p_{5y}	—0.5333	—0.9094	—0.3226	—0.5111
	indirect	$p_{4y}r_{45}$	0.3179	0.1137	0.0338	0.1514
		$p_{6y}r_{56}$	—0.7683	—0.1882	—0.6629	—0.6295
	total (r_{5y})		—0.9837	—0.9840	—0.9517	—0.9892
x_6	direct	p_{6y}	—0.8827	—0.7237	—0.8496	—0.9008
	total (r_{6y})		—0.8827	—0.7237	—0.8496	—0.9008

x_1—x_6: see in the Fig. 8.

Factors determining the variability of crop weights

When examining the crop yield we emphasize that the crop weight showed a negative correlation with all the growth characteristics. However the direct effects of the characteristics are positive in the case of NAR; they are of negative tendency only in LAR and RGR. This means that the extent of the indirect effect of negative tendency and of the common effects of NAR is significant.

In the KM-622 variety, the variance of the crop weight is primarily determined by RGR; this characteristic has a very high indirect effect, 70—80%. In relation to the characteristics NAR and LAR, the indirect effects are mainly significant.

The direct influence of RGR on the variance of the crop weight is high also in the KV-1 variety. In comparison with the KM-622 variety, the direct and indirect effect of NAR is also much greater in the growth area of Kalocsa, while this is valid in a reversed way at Vácrátót. The indirect effects of LAR are smaller in the KV-1 variety than in the KM-622 one, in both areas. The latter characteristic however has a strikingly high direct effect on the variance of the crop weight.

Table 26
Path-coefficients between variables

Varieties / Variables	KM-622			
	NAR	LAR	RGR	yield weight (W)
Vácrátót				
Total precipitation	—1.6637	1.5756	—0.0505	—
Mean temperature	1.1991	—0.5233	—0.0625	—
Radiation minimum	0.1167	0.0255	0.0637	—
NAR	—	—	0.5985	0.4753
LAR	—	—	0.4701	—0.5333
RGR	—	—	—	—0.8827
P_E	0.0750	0.2740	0.2450	0.3300
Kalocsa				
Total precipitation	0.0753	0.5271	0.0426	—
Mean temperature	0.0816	0.2154	—0.0908	—
Radiation minimum	0.0665	—0.1869	0.0399	—
NAR	—	—	0.6231	0.0953
LAR	—	—	0.5593	—0.3226
RGR	—	—	—	—0.8496
P_E	0.9440	0.8480	0.1670	0.1233

Varieties / Variables	KV-1			
	NAR	LAR	RGR	yield weight (W
Vácrátót				
Total precipitation	—0.1631	0.1111	—0.0851	—
Mean temperature	0.5775	0.1936	—0.1843	—
Radiation minimum	—0.0870	0.3255	0.1298	—
NAR	—	—	0.7499	0.3150
LAR	—	—	—0.0105	—0.9094
RGR	—	—	—	—0.7237
P_E	0.7320	0.3880	0.7010	0.3360
Kalocsa				
Total precipitation	—0.4393	0.6748	—0.0311	—
Mean temperature	0.3650	0.3872	—0.0504	—
Radiation minimum	—0.0350	0.2249	0.0873	—
NAR	—	—	0.7663	0.3279
LAR	—	—	0.3450	—0.5111
RGR	—	—	—	—0.9008
P_E	0.6860	0.2980	0.0374	0.3320

P_E: error path coefficient.

Table 27

Partition of coefficients determination, Kalocsa

Total precipitation NAR	v (%)	z (%)	Total precipitation LAR	v (%)	z (%)
Direct effect	0.60	19.30	Direct effect	27.80	45.50
Indirect effect			Indirect effect		
via x_5	3.50	9.70	via x_4	0.10	4.10
via x_2	—	0.30	via x_2	0.10	0.40
	3.50	10.00		0.20	4.50
Common effect	2.10	—25.90	Common effect	—0.80	—33.20
Residual effect	93.80	96.60	Residual effect	72.80	83.20

Mean temperature NAR	v (%)	z (%)	Mean temperature LAR	v (%)	z (%)
Direct effect	0.70	13.30	Direct effect	4.60	15.00
Indirect effect			Indirect effect		
via x_5	0.60	3.20	via x_4	0.10	2.80
via x_3	0.40	0.10	via x_1	0.70	1.10
via x_1	—	0.50	via x_3	2.80	4.10
	1.00	3.80		3.60	8.00
Common effect	2.60	16.70	Common effect	—8.10	19.70
Residual effect	95.70	66.20	Residual effect	99.90	57.30

Radiation minimum NAR	v (%)	z (%)	Radiation minimum LAR	v (%)	z (%)
Direct effect	0.90	0.10	Direct effect	3.50	5.10
Indirect effect			Indirect effect		
via x_5	0.40	1.10	via x_4	0.10	—
via x_2	0.50	10.70	via x_1	0.70	—
	0.90	11.80	via x_2	3.70	12.00
				4.50	12.00
Common effect	—0.90	3.90	Common effect	—7.20	14.50
Residual effect	99.60	84.20	Residual effect	99.20	68.40

v: KM-622; z: KV-1; x_1—x_5: see in the Fig. 8.

Table 28

Partition of coefficients of determination, Kalocsa

Total precipitation RGR	v (%)	z (%)	Mean temperature RGR	v (%)	z (%)
Direct effect	0.20	0.10	Direct effect	0.80	0.25
Indirect effect			Indirect effect		
via $x_4+(x_5+x_4)$	1.60	—	via x_3	0.10	0.61
via x_5	8.70	5.42	via $x_3 + x_4$	0.10	0.06
via x_2	—	0.01	via $x_1 + x_4$	—	0.27
via $x_2 + x_4$	—	0.19	via x_4	0.30	7.82
via $x_5 + x_4$	—	5.79	via $x_4 + x_5$	0.20	1.88
via x_4	—	11.33	via $x_1 + x_5$	0.20	0.13
via $x_4 + x_5$	—	0.49	via $x_3 + x_5$	0.90	0.48
via x_5	—	5.42	via x_5	1.50	17.80
via $x_2 + x_5$	—	0.04	via $x_5 + x_4$	—	0.34
	10.30	23.18		3.30	29.39
Common effect	14.40	—23.20	Common effect	—2.90	36.10
Residual effect	75.10	99.92	Residual effect	98.80	34.26

NAR — RGR	v (%)	z (%)	LAR — RGR	v (%)	z (%)
Direct effect	38.80	58.72	Direct effect	31.30	11.90
Indirect effect			Indirect effect		
via x_5	3.90	2.54	via x_4	4.90	12.52
Common effect	24.70	24.40	Common effect	24.70	24.40
Residual effect	32.60	38.70	Residual effect	39.90	51.80

Radiation minimum RGR	v (%)	z (%)
Direct effect	0.20	0.76
Indirect effect		
via x_2	0.70	0.20
via x_4	0.20	0.07
via $x_5 + x_4$	0.20	0.63
via $x_2 + x_4$	0.20	6.27
via x_5	1.10	0.60
via $x_2 + x_5$	1.20	1.43
	3.60	9.20
Common effect	—3.70	19.10
Residual effect	99.90	70.94

v: KM-622; *z*: KV-1; x_1—x_5: see in the Fig. 8.

Table 29

Partition of coefficients of determination, Vácrátót

Total precipitation NAR	v (%)	z (%)	Total precipitation LAR	v (%)	z (%)
Direct effect	276.79	2.66	Direct effect	245.25	1.23
Indirect effect			Indirect effect		
via x_5	111.11	0.16	via x_4	123.88	0.35
via x_2	8.69	2.01	via x_2	1.65	0.23
via x_3	0.45	0.25	via x_3	0.02	3.53
	120.25	2.42		125.55	4.11
Common effect	—390.90	—5.00	Common effect	—361.70	3.00
Residual effect	93.86	99.92	Residual effect	87.90	91.66

Mean temperature NAR	v (%)	z (%)	Mean temperature LAR	v (%)	z (%)
Direct effect	143.78	33.35	Direct effect	27.38	3.75
Indirect effect			Indirect effect		
via x_3	2.22	0.53	via x_3	0.05	7.44
via x_1	16.72	0.16	via x_4	64.35	4.34
via x_5	12.26	0.49	via x_1	15.00	0.07
	31.20	1.18		79.40	11.85
Common effect	—140.30	—5.90	Common effect	—59.50	33.80
Residual effect	65.32	71.37	Residual effect	52.72	50.60

Radiation minimum NAR	v (%)	z (%)	Radiation minimum LAR	v (%)	z (%)
Direct effect	1.36	0.76	Direct effect	0.07	10.60
Indirect effect			Indirect effect		
via x_5	0.03	1.38	via x_2	19.22	2.63
via x_2	100.93	23.41	via x_1	82.71	0.41
via x_1	92.22	0.89	via x_4	0.61	0.10
	193.18	25.68		102.54	3.14
Common effect	—191.40	—8.70	Common effect	—69.50	13.50
Residual effect	96.86	73.56	Residual effect	66.89	72.76

v: KM-622; z: KV-1; x_1—x_5: see in the Fig. 8.

Table 30

Partition of coefficients of determination, Vácrátót

Total precipitation RGR	v (%)	z (%)	Mean temperature RGR	v (%)	z (%)
Direct effect	0.35	0.72	Direct effect	0.39	3.40
Indirect effect			Indirect effect		
via x_2	0.02	0.21	via x_1	0.02	0.04
via x_3	0.14	0.56	via x_3	0.28	1.18
via $x_2 + x_4$	3.11	1.13	via $x_1 + x_4$	5.99	0.09
via $x_3 + x_4$	0.16	0.14	via $x_3 + x_4$	0.34	0.30
via $x_5 + x_4$	39.80	0.09	via x_4	51.50	18.75
via x_4	99.15	1.50	via $x_5 + x_4$	4.39	2.70
via $x_4 + x_5$	27.38	—	via $x_1 + x_5$	3.31	—
via x_5	54.86	—	via $x_3 + x_5$	0.01	—
via $x_2 + x_5$	0.37	—	via x_5	6.05	—
	224.99	3.63	via $x_4 + x_5$	14.22	—
				86.11	23.06
Common effect	—225.00	—3.80	Common effect	—48.20	—15.40
Residual effect	99.60	99.45	Residual effect	61.70	88.94

NAR — RGR	v (%)	z (%)	LAR — RGR	v (%)	z (%)
Direct effect	35.82	56.24	Direct effect	22.10	0.01
Indirect effect			Indirect effect		
via x_5	9.89	—	via x_4	16.30	7.32
Common effect	37.60	—0.60	Common effect	37.60	—0.60
Residual effect	16.69	44.36	Residual effect	24.27	93.27

Radiation minimum RGR	v (%)	z (%)
Direct effect	0.41	1.68
Indirect effect		
via x_1	0.12	0.24
via x_2	0.27	2.38
via x_4	0.49	0.43
via $x_5 + x_4$	0.01	0.78
via $x_1 + x_4$	33.03	0.50
via $x_2 + x_4$	36.15	13.16
via x_5	7.29	—
via $x_4 + x_5$	0.13	—
via $x_1 + x_5$	18.28	—
via $x_2 + x_5$	4.25	—
	100.02	17.49
Common effect	—62.80	—13.60
Residual effect	62.37	94.43

v: KM-622; z: KV-1; x_1—x_5: see in the Fig. 8.

Table 31

Partition of coefficients of determination

NAR — W	v (%)	z (%)	LAR — W	v (%)	z (%)
Kalocsa					
Direct effect	0.90	10.75	Direct effect	10.40	26.12
Indirect effect			Indirect effect		
via x_5	1.31	5.57	via x_4	0.11	2.29
via x_6	28.02	47.65	via x_6	22.58	9.66
via $x_5 + x_6$	2.84	2.06	via $x_4 + x_6$	3.52	10.16
	32.17	55.28		26.21	22.11
Common effect	18.30	—11.00	Common effect	53.90	49.70
Residual effect	48.62	44.97	Residual effect	8.98	2.07

RGR — W	v (%)	z (%)
Direct effect	72.18	81.14
Residual effect	27.82	18.86

NAR — W	v (%)	z (%)	LAR — W	v (%)	z (%)
Vácrátót					
Direct effect	22.59	9.92	Direct effect	28.44	82.70
Indirect effect			Indirect effect		
via x_5	12.73	10.77	via x_4	10.11	1.29
via x_6	27.91	29.45	via x_6	17.22	0.01
via $x_5 + x_6$	7.70	—	via $x_4 + x_6$	12.49	3.83
	48.34	40.22		39.82	5.13
Common effect	—23.70	—19.60	Common effect	28.50	8.90
Residual effect	52.77	69.46	Residual effect	3.24	3.27

RGR — W	v (%)	z (%)
Direct effect	77.90	52.37
Residual effect	22.10	47.90

v: KM-622; *z*: KV-1; x_1—x_6: see in the Fig. 8.

Table 32

Effects (%) of various factors on the variability of RGR and yield weights (W) (partition of multiple determination coefficient)

RGR	Vácrátót		Kalocsa	
	KM-622	KV-1	KM-622	KV-1
Direct effects				
Total precipitation	0.35	0.72	0.18	0.09
Mean temperature	0.39	3.39	0.82	0.25
Radiation minimum	0.40	1.68	0.15	0.76
NAR	35.82	56.23	38.80	58.72
LAR	22.09	0.01	31.29	11.90
	59.05	62.03	71.24	71.72
Common effects	33.71	—11.12	25.93	24.54
Residual effects	7.24	49.09	2.83	3.74
W (yield weight)				
Direct effects				
NAR	22.59	9.92	0.90	10.75
LAR	28.44	82.70	10.40	26.12
RGR	77.90	52.37	72.18	81.14
	128.93	144.99	83.48	118.01
Common effects	—39.80	—56.30	15.00	—29.00
Residual effects	10.87	11.30	1.52	10.99

Comparison between habitats

The effect of meteorological factors on the variability of the growth characteristics

Meteorological factors determine the variance of RGR only to a very small extent directly in both growing areas. An essential difference is that at Vácrátót the indirect effects of all three environmental factors are very great, while this was not experienced in the growing area of Kalocsa.

In relation to NAR and LAR, the direct and indirect effects of the external factors are very high in the cultivation area of Vácrátót, while in that of Kalocsa these effects are small.

The effect of growth characteristics on the variability of crop weights

In the KM-622 variety, according to the system constructed by us, the variance of crop weight is to a greater extent determined by the growth characteristics NAR, LAR and RGR both directly and indirectly in the growing area of Vácrátót than in that of Kalocsa.

In the KV-1 variety, the very much greater direct LAR effect and the smaller direct effect of RGR in the Vácrátót area than in the Kalocsa area should be emphasized.

The most essential similarity in both areas and in both varieties is that the direct effect of LAR on crop weight is always much greater than that of NAR.

Summary

On the basis of growth analyses we can summarize the following statements:

Changes in the growth characteristics

Irrespective of the growing area, in both red pepper varieties, the periodical changes in the growth characteristics show similar tendencies, but there are essential differences in the size of value of characteristics.

In the KM-622 variety, the top value of NAR is greater, and the values of this characteristic are greater throughout the whole vegetation period, than in the KV-1 variety.

The RGR values, calculated for the total weight of the plant, and for each of the plant organs, further, the yearly "averages" of NAR are always higher in the KM-622 variety, while value of LAR is always smaller and its decrease is stronger than that in the KV-1 variety.

It is characteristic of the KM-622 variety, which has a higher NAR, that its dry matter production falling to one unit of leaf area is greater, the crop yield is more and the growth rate of crop weight is quicker than that in the KV-1 variety.

Thus the KM-622 variety can be considered as a more efficient variety in relation to the assimilation activity and organic matter production.

Moreover, considering the weight changes and the values of growth characteristics, it can be stated that in the growth processes of the varieties there are several common features. It is essential however that in the growth area of Kalocsa — which is optimal for pepper growing — the differences in the varieties are much greater than those occurring in the varieties of the Vácrátót area which is less unfavourable for pepper growing.

Correlations between the individual growth characteristics and between the growth characteristics and crop weights

In both varieties, and in both growth areas there is a close correlation between RGR and NAR, and between RGR-RLGR.

We emphasize that in both varieties the correlations between RGR_{crop}-LAR, and RGR_{crop}-RGR_{total} are stronger than that between RGR_{crop} and NAR. A similar correlation with opposite sign is characteristic of the relationship between crop weight and growth characteristics.

In relation to RGR_{crop}-LAR, crop weight-LAR, the differences in varieties are worthy of note; these correlations show a very close link only in the case of the KM-622 variety. In this variety, in relation to all the growth characteristics, the RGR_{crop}-LAR correlation was the highest, while in the KV-1 variety a low correlation value was obtained.

Correlations between the meteorological factors examined and the growth characteristics, as well as the crop weights

In the growing area of Kalocsa, in the pepper varieties, the growth characteristics and the crop weights have hardly any or no correlation indicating a close link with the environmental factors drawn into the analyses.

In the growing area of Vácrátót, which owing to the climatic and soil conditions is rather unfavourable for pepper growing, the meteorological factors examined make their influence felt much more than in the growth area of Kalocsa. In the case of the growth characteristics and the external factors there can be strong positive resp. in the case of crop weights strong negative correlations exist.

The results of path analysis

Path analysis results have shown that the variance of NAR is to a great extent influenced by the mean temperature which had a direct effect almost exclusively. The precipitation value had a most striking effect on LAR. In both varieties, the greatest direct effect on RGR was exerted by NAR, while LAR had this effect only in the case of KM-622.

The greatest direct effect on the variance of the crop weight was exerted by LAR in both varieties and in both areas; the direct effect of NAR and RGR is of a much smaller size.

In comparing the differences in growing areas, it can be stated that in the growing area of Vácrátót, the direct and mainly the indirect effects of the external factors on the variance of NAR and LAR, are high and their indirect effect on the variance of RGR is very high, while this could not be experienced in the growing area of Kalocsa.

ACKNOWLEDGEMENTS

I owe my thanks to dr. K. KAPELLER, Director of the Research Centre for Red Pepper, Kalocsa, who made it possible for us to carry out our investigations in their experimental area, and who provided us with help in the course of samplings; to dr. I. PRÉCSÉNYI, D. Sc. (biol.) Head of Department of Botany, for suggesting the subject, and for the assistance provided at the initial phase of the work; and to dr. A. BORHIDI, D. Sc. (biol.) Deputy Director of the Research Institute for Botany of the Hung. Academy of Sciences (Vácrátót), for supporting our work and keeping a surveillance during the whole course of our study.

I express my gratitude to dr. G. FEKETE, D. Sc. (biol.) Scientific adviser, for his multilateral professional assistence; and to dr. J. NOSEK, Research Fellow, for his advice and help in discussing problems that arose during my work.

Last but not least I should like to thank Mrs B. TÓTH for her conscientious work, Mrs J. DINKA and Miss I. DIVALD, laboratory workers; and all those who contributed in any form to the preparation of this paper.

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RECENSIONES

Flora Europaea Vol. 5. Alismataceae to Orchidaceae (Monocotyledones). Eds: Tutin, T. G.—Heywood, V. H.—Burges, N. A.—Moore, D. M.—Valentine, D. H.—Walters, S. M.—Webb, D. A. with the assistance of Chater, A. O. and Richardson, I. B. K. — Cambridge University Press, 1980, 451 pp., 5 maps.

With the publication of the long-awaited fifth volume one of the most important international enterprises of botany, Flora Europaea has been born. With the creative participation of more than 200 specialists this work, is the first complete up-to-date summary of the flora of the European continent. It is rightly considered by botanists to be a standard on questions of nomenclature and a basic source material for further taxonomical research. Volume 5 prepared with the collaboration of 59 authors contains the European monocotyledons on 350 pages, as well as an appendix, author indices containing the key of the abbreviations used for the cited books and periodicals, a list of technical terms, a Latin-English vocabulary, the list of synonyms and taxa discussed in Volume 5, and finally the family and genus index of the full 5-volumed series. At the end of volume 5 maps help in the understanding and identification of the distribution data.

As is almost unavoidable in flora works prepared in collaboration with a great number of authors, the unevenness of conceptions and elaborations is detectable in the fifth volume of Flora Europaea as well. In most of the families, but especially in the elaborations of the Gramineae, the taxonomical conception and practice of today follow there is a trend towards the division of genera. In contrast with this, with respect to the *Cyperaceae* family, there is a fusion of the genera that is quite new to the European taxonomical conception and traditions. It is difficult to understand that no suitable European specialist could be found by the editorial board for the elaboration of the genera *Scirpus* and *Cyperus*. It is even less understandable that an elaboration reflecting an earlier American taxonomic concept (cf. K. Svenson: N.-Amer. Fl. 18, 1947—1957) was accepted even though, it was based on the research of C. B. Clarke and recently T. Koyama has refuted it even in America (see: T. Koyama: Cyperaceae in Howard, R. A.: Flora of the Lesser Antilles 3).

In studying the elaboration of the individual genera it can be stated that there are great differences in standards among the performances. The most successful are the generic elaborations made by specialists (e.g. Markgraf-Dannenberg, Martinovsky, Soó), whereby the most complicated and taxonomically most problematic genera (e.g. *Festuca*, *Stipa*, *Ophrys*, *Orchis*, *Dactylorhiza*) are presented.

Nevertheless the elaboration of the *Koeleria* genus cannot at all be considered as successful. Its author (C. J. Humphries), has not even made an attempt to take the results of the cytotaxonomical and anatomical examinations of J. Ujhelyi into consideration who is acknowledged as the monographer of this genus. The author of this study does not mention that there is a conception according to which the genus is divided into numerous poliploid series although it is a fact. In Humphries' interpretation, *Koeleria macrantha* and other species are obviously "collective species". When under one species name there are 10 synonyms and 6 various chromosome numbers without differentiation of any subspecific taxa usually means that the taxonomist has not been able to obtain satisfactory knowledge of his material.

Admittedly, satisfactory knowledge about a number of genera is still missing, and further research will considerably modify the elaborations published in the volume (e.g. *Koeleria*, *Molinia*, *Phleum*). It can probably be explained by the dead line of the volume that *Phleum hubbardi* D. Kováts has not been taken into consideration.

It seems that no unified view could be taken with respect to the species and subspecies concept, not even for the taxonomic rank to be received by chromosome races. Subspecies category is used arbitrarily by a number of authors, and does not meet either its morphological or phytogeographical criteria. In this respect, Soó's concept in the genera *Ophrys* and *Orchis*, or STEARN's concept in the case of *Allium flavum* and *tauricum* can be considered as examplary; on the other hand, it seems unjustifiable to consider *Allium jajlae* Vved., *A. rotundum* L. and *A. Waldsteinii* G. Don as the subspecies of *Allium scorodoprasum* L.

It should be mentioned among the virtues of Volume 5 that a more determined endeavour can be felt here than in the earlier volumes to achieve a more adequate survey of the taxonomic richness and variations of the South-East-European flora.

Similarly as in the earlier volumes of Flora Europaea, also in the present one it is a great asset that the nomenclature has been given in most adequate, accurate way. Naturally, in a work of this size it is unavoidable that a few smaller inaccuracies occur; e.g.:

Dasypyrum villosum (L.) P. Candargy 1901 = *Dasypyrum villosum* (L.) Borbás 1897
Nectaroscordum siculum ssp. *bulgaricum* (Janka) Stearn 1978 = *Nectaroscordum siculum* ssp. *bulgaricum* (Janka) Borhidi. Acta Bot. Acad. Sci. Hung. 13, 197. 1967.

Some shortcomings in the data of the distribution: according to Flora Europaea — incorrectly — *Festuca wagneri* Degen, Thaisz et Flatt and *Poa pannonica* A. Kern. do not occur in Hungary.

Obviously, the shortcomings enumerated here or others as well, do not lessen the greatness and success of the undertaking. The 5 volumes of Flora Europaea represent a significant summarizing work on the flora of the continent, and it must not be absent from the library of any botanical institute. This work should be used by all the taxonomists with respect and criticism. Respect on account of the enormous undertaking and endeavour to make a synthesis, and to expose the problems in the perspective of future research. At the same time, the pages of this great work must be read with a critical mind for in a number of places it needs touching up, and the authors themselves indicate in many cases that further research is necessary.

It is not likely that within a foreseeable future a similar undertaking will be realised. Nevertheless, if a newer Flora Europaea, more successful than the present one, would be attempted, then a more thorough consideration should be given to the floral richness of the Balkan Peninsula — as the greatest secundary evolution centre of the European flora — and the taxonomy experts of the continent shall have to be relied upon to a greater extent

A. BORHIDI

HOWARD, A. R.: Flora of the Lesser Antilles (Leeward and Windward Islands). Vol. 3. Monocotyledonaeae. Ed. BROOKE THOMPSON-MILLS. — Arnold Arboretum Harward University. 1979, 586 pp.

The endangered state and rapid destruction of our natural environment urges botanists to comprehend explore and reckon up the flora of the Earth, without which effective conservation cannot be realized. The exploration and reckoning up insular floras is especially important, since they are abundant consisting mostly of native endemic species. Since they can be extremely endangered by anthropic effects, this alone accentuates the importance and need for working on flora of the Lesser Antilles.

It is most apt nowadays to make a critical assessment of research on the extremely rich insular flora of the West Indies. The floras of the individual islands have already become known quite well, a synthetical flora work surveying the whole archipelago is however still missing. To launch such a synthesizing job needs — as a pilot work — the elaboration of a critical comparative flora of the most divided island group, the Lesser Antilles. Therefore, HOWARD's Flora is not only an important, highly-desired enterprise but also a pioneering one, a fundamental work, on which further flora studies of the Antilles can be based, and even a whole synthesis of the flora on the West-Indies, in the not too near future. The first two volumes on the Flora of the Lesser Antilles, Orchids and Pteridophytes were published in a modern, excellent elaboration by Leslie A. GARAY and G. M. PROCTOR respectively. Volume 3, from the writings of R. A. HOWARD, contains the other families of Monocotyledons. The elaboration of some critical families was produced by widely recognized specialists such as Frank G. GOULD *(Gramineae)*, Tetsuo KOYAMA (*Cyperaceae*), Paul J. M. MAAS (*Burmanniaceae, Cannaceae, Zingiberaceae*), and R. W. READ (*Palmae*).

The high professional standard of the volume, the adequate keys, the clear descriptions, the attractive lay-out, and the 122 fine figures presented in it are to be appreciated.

A special emphasis should be placed on the uniform, up-to-date taxonomical conception prevailing throughout the volume. This is almost unique in a volume written by several authors. The modern conception and trends in taxonomical research have been considered and given prevalance in the right way by the authors, who have managed the taxonomical categories consistently and accurately. Fortunately, the authors neglected the not too rarely found simplifying concept that the Antilles would be a kind of appendix to the American continent, and as a consequence a large part of the plants in the Antilles should be considered as a subspecies or a variety of different continental taxa. An exceptionally thorough knowledge of the materials, clear judgement and team collaboration have resulted in a volume devoid of any conceptual distortion.

In Volume 3 of the floral work, 34 families, 189 genera and 507 species are discussed in detail. After the description of the families, and the genera respectively mention is made of the genus type, the species type, the number of the belonging species, the geographical distribution and habitat, as well as the important research preliminaries, taxonomical remarks related to a particular taxon. The keys of the genera and the species are clear and easy to use. The multiple-graded keys of *Gramineae* are also successful. The descriptions of the individual species are introduced with their valid plant and author name which is always accompanied by an accurate citation of the reference works. This is followed by the data of the basionym, and the type specimen, then by the complete enumeration of the synonyma. The concise description of the species and of other taxa, which nevertheless contains all important details, is followed by general data on distribution, occurrence in the Lesser Antilles, habitat, common names, as well as by critical remarks and explanations related to the taxonomy of the species.

A great merit of the volume is the modern approach of the family *Cyperaceae* which at last broke away with the obsolete sensu lato concept of the *Scrirpus* and *Cyperus* genera.

The laborious and meticulous research work for types and original descriptions followed by their comparison and critical elaboration is most noteworthy. This work is also uniquely important and valuable because the descriptions made by the first researchers of the neotropical flora, that is by the botanists in the second half of the 18th century, were very often based on plants of unknown origin, and these plants actually proved to be living in the Lesser Antilles. The short diagnoses used at that time, and the uncertain origin of the type — very often only a drawing or a picture — led to a great deal of taxonomical misunderstandings, a considerable portion of which has not been resolved up to the present day. In Volume 3 of the Flora of the Lesser Antilles, the questions of a great number of such critical plant species have been clarified, or are a source for the solving of the questions.

The extremely careful edition of this work is indicated by the fact that it is almost impossible to find any mistake in the whole volume. The pictures of Figs 105 and 106 are changed, and the type face of some species in the index (e.g. *Eleusine indica*, *Anthurium lanceolatum*, *Gynerium sagittatum*) is not correct.

In summary Volume 3 of the Flora of the Lesser Antilles is a modern elaboration employing a unified taxonomic concept, high scientific standard, and very fine editing work, which serves as an essential source not only for the researchers of the Antilles, but is indispensable for the specialists and institutions interested in the research of the neotropical and pantropical flora. Its conception, structure and lay-out can be taken as an example by works on flora under preparation from other areas of the West Indies at present. We are looking forward to the publication of its further volumes.

A. BORHIDI

K. KUBITZKI: Flowering Plants Evolution and Classification of Higher Categories. — Plant Systematics and Evolution, Suppl. 1 — Symposium, Hamburg, Sept. 8—12. 1976. Springer Verlag, Wien 1977, 416 pp. with 118 figures

In the scientific development of today the causative and comparative viewpoints of research have assumed prominence. Modern plant taxonomy incorporates even more of thei results of related branches of sciences into its evaluation. Even more important than this, is the method to be developed in part areas at issue. The time has come for us to reach mutual agreement with regard to the varieties and extent of most recent techniques and work hypotheses that can be taken over or developed in plant taxonomy.

The greatest changes in the taxonomy of today have been triggered off by biochemistry and mathematics breaking into its field. We are witnesses of a new branch of science, chemo-

taxonomy, gaining ground both in taxonomy and the other branches of biology (schools of CRONQUIST, and HEGNAUER). Under the effect of the results the position occupied so far by even whole taxonomical units can become questionable, and a complete revision certain groups may become necessary. In all branches of biology, emphasis is shifting from the examination of individuals and species increasingly more to a deeper exploration of the entirety of life communities, and to the regularities of these. The new task necessarily requires also the spreading of new methods which will make fast and reliable processing of the almost unsurveyable mass of data possible. This is why biometry has become an indispensable means for specialists. To improve the objectivity of the results, and to reduce the necessary working time, newer and newer statistical calculation methods and even whole analysis programme systems, have come into being and by combining computer techniques, even such results will be available that could not attained otherwise.

Satisfactory solution of the problems that arise is an urging task all the more so because the basic principles of taxonomy have become uncertain. In order to collate the questions at an international level, a taxonomical symposium was organized in Hamburg, and the lecture delivered there were edited in this work by Professor Klaus KUBITZKY, Head of Department of the Hamburg University Institute of General Botany.

Each topic of the session has been analysed by an internationally acknowledged specialist of the field, in 22 lectures altogether, the grouping of which also hall-marks the essential targets of the symposium: firm and uniformly accepted principles and viewpoints must be elaborated together with suitable methods, then building on these, the maximum harmony must be achieved between taxonomy and evolutionary factors. This will enable us to categorize and explain higher taxonomical units true to reality. Accordingly, the lectures are drawn into three large groups, viz. that of basic principles and methods; a group of analyses dealing with the relationship between taxonomical evidence and evolutionary viewpoints; and finally the group of lectures summarizing recent research into taxonomical problems of higher taxa.

The lecturers of the first topic (BURTT, B. L.—CAGNIN, M. A. H.—CLIFFORD, H. T.—HEYWOOD, V. H.—KUBITZKI, K.—MEEUSE, A. D. J.—SPORNE, K. R.) all agree that the greatest and general shortcoming in plant systems today is: explanation is little, unfounded or none at all. We must give scientifically founded, satisfactory answers to the increasing number of why-s in order to enable plant to be categorized in an evolutionary order which is close to reality. Accordingly, we have to try to avoid designing a system of shelves built upon each other artificially, but to create a living reality from the individual evolutionary lines and trends. For this however we need to change our outlook for the taxon compartmentization we are used to and predetermined in advance, may divert our systematizing activity in a wrong direction from the outset. The newer research results may create in some taxa for in most cases it was simply on respects that they were categorized lacking satisfactory scientific proofs.

The groupings applied so far almost exclusively on the basis of comparative morphology are hardly suitable for a nuvalid reconstruction of the plant kingdom. Data on phylogenetics of only referring to phylogenetics by means of which taxa of subspecies could be placed with scientific certainty into an evolutionary order are very few in general. Often the evolutionary reference is expressed in loose monophyletism and no more. If we wish to reach an acceptable phylogenetic explanation a full and exhaustive review of the individuals of the taxon will have to be carried out and for that complex taxonomic methods will have to be applied. Most of the examples presented in the lectures however classify, invariably according to only a few viewpoints, that is, we do not see examples of classification on the basis of complex investigations. This however, is understandable if we consider the extremely complex and time-consuming character of the work. It is quite obvioŭs that this on the whole, can be realized only by means of international cooperation. One of the greatest obstacles is that in taxa of subspecies the taxonomists do not by any means take a uniform standpoint. This is indicated by the frequent debates on the family limits, especially of those described recently. Repeatedly, to this a reassuring answer could only be given by such genus or species monographs that use either revised and up-to-date or complex methods. This is why work of this kind has again assumed immense importance.

In the second part of the book, the authors (BEHNKE, H.-D.—CRONQUIST, A.—EHRENDORFER, F.—GOTTSBERGER, G.—GOTTWALD, H.—HEGNEAUER, R.—KRACH, J. E.—PHILIPSON, W. R.) present amply illustrated the standard of evolutionary outlook prevailing in the systematization of today.

The great number of new methods presenting evolutionary data, is proof enough of the strivings for new investigations which however entail complex equipment which hinders thein widespread application. The question of method which was the central issue of debate

either openly or in an implied form during the whole session has again emerged. Serious consideration should be given as to whether the methods accepted in other branches of science can be used and to what extent in the world of living organisms; and within this, in the plant kingdom. (Thus, the phylogenetical reconstruction consistently based on bifurcation developed in the animal taxonomy of W. Hennig 1950). There is common agreement on the fact that work should be designed so as to cover the possible widest sphere, and huge data mass, by using all the advantages of computer processing. The setting up of an international data base is most urgant which would be suitable for storing and processing the mass of data arriving from everywhere.

Although the delimitation of the family category is in the focus of interest, from an evolutionary viewpoint the problem of higher units, primarily that of orders is not negligible either. In our systems considered as up-to-date, these are exactly delimited, however, the basis of systematization is different in the various taxonomical systems. Hardly any unambiguous reasonable explanation of the orders occupying the relevant place in the system, can be found and in this way they seem to be even more arbitrary units than the family. The content of the orders of certain taxonomists is so diverging that under such circumstances it is almost meaningless to speak of evolutionary affinity. It was in connexion with this that the question of taxonomic charts was also raised in the course of discussions. It was unanimous by agreed that the two-dimensional taxonomic charts used today simplify reality to such an extent that they should only be allowed for didactical purposes. In this closing series of lectures (Berg, C. C.—Dahlgren, R.—Endress, P. K.—Huber, H.—Thorne, R. F.—Wagenitz, G.) interesting suggestions were made on the compensation of subjective factors acting of necessity, on the design of working hypothese, on the taxonomical use of physiological processes and on the solution of many other questions of detail.

According to the closing remarks of H. Merxmüller, the main achievement of the Symposium was the launching of the elaboration of a new, up-to-date evolution-centred international working method a basic condition of which was agreement on the most important questions of principle.

The work provides with specialists exhaustive information on the very ramifying and complicated problems of plant systmatization which have occurred in the past two decades. Thus it will be indispensable primarily for biologists dealing with the theory of modern taxonomy, but it may be well of great assistance in constitutions carrying out various taxonomical research as well. Further more botany gardens, and museums demonstrating the subject the living world either in the form of a survey or in detail, could well utilize the instructions of the lectures which are chiefly of a methodological character. Every reader who is familiar with natural sciences may realize from struggle waged by science this frankly critical volume that tremendous and persevering true exploration of the evolution of nature.

Z. Kereszty

Flowering plants of the world. Consultant editor: V. H. Heywood. Oxford University Press 1978, 335 pp.

As regards both its professional standard and its artistic-technical layout the book is a fully note-worthy production. Actually, it is difficult to decide whether it has been designed for laymen or for specialists, but it will indeed be of use for both strata of readers; it was even its purpose — as we learn this from the preface — to bring the educated laymen nearer to the specialists.

The target of the work was to survey the whole plant world on a family level. As a preliminary chapter, the introduction contains a general survey of the plant kingdom, but it is mainly a short insight into some of the basic principles of classification, which touches upon the hierarchy of the plant system and which originates from V. H. Heywood. The introduction is followed by a complete system of families by Superorder and Order, then by a 11-page glossary.

As regards the specific part, the way of discussing a family by and large is as follows: Distribution (a short area-geographical summary): horizontal-vertical distribution, enumeration of the main formations in which the taxa of the family take part); Diagnostic features; Classification (in greater families, system within the family; sub-families; a concise morphological-chorological characterization of greater genera); the enumeration of economic uses. More than 300 families of the world's Angiosperms are described in this book. In general, the following viewpoints are emphasized: the dominant prevailing life form of the family;

the important species which have commercial, economic, ornamental or pharmaceutical significance; kinship relations with other families. The distribution of each family is demonstrated in a small map, indicating the number of genera and species. The larger families are illustrated in colour plates occupying in their majority fully pages with a presentation of the characteristic representatives. The task of these figures is above all to create a habitual picture, while that of the figures in the text — which are of a great number and of a characteristically soft greyishbrown shade — is to show us the details essential also from the viewpoints of systematization, and primarily the characteristics of the generative organs.

The figures, having identical value and significance with the text, were created by artists V. GOAMAN, J. DUNKLEY, CH. KING. Along with the 44-membered authors' team, they also deserved a share in the success in the wake of which "Flowering plants of the world" has become a unique product of scientific-propagating literature serving the needs of both fields.

G. FEKETE

A. MAJER: A Bakony tiszafása (The yews of the Bakony). Akadémiai Kiadó, Budapest 1980, 373 pp.

The second greatest stand of yews in Europe is to be found in the Bakony mountain (Hungarian Central Mountains Range in Transdanubia), where nearly 120,000 individuals grow in a not too large area. It is more than one hundred years now that the first information on it appeared in the literature, and even though this was followed by numerous studies and various publications it can be stated that these publications contained only little original information and were reiterations. Therefore, this book will no doubt be welcomed. It comprises the observations — which started almost 50 years ago — and multidirectional in situ investigations as well as data collection by Antal MAJER, Professor of the Department of Arboriculture in the Sopron University of Forestry and Wood Industry.

In the first chapter, entitled Botanical Characteristics of the yew tree, a general characterization is given. The original is represented by the trunk analysis from the point of view of forestry of an old specimen, and also the characterization of the renewal conditions of the plant. — The next chapter summarizes the habitat factors by presenting geographical, geological, climatological, and soil mechanical implications as well as original micro-climate- and soil investigations. The economic and other human infuences on the area are framed in the chapter entitled "The Historical Relevances of the Woods an of the Yews of Szentgál", in which a socio-historical, estate-historical and economic-historical picture of the special hunters' community of the nearby village of Szentgál is drawn. There are 6 vegetation types in the communities rich in yew trees, and in beeches mixed with yew trees; the tabular description, the questions of topographical localization, the various detailed cenological structures, the characterization according to area type and life form, — all with their volumenous presentation emphasize the centre of focus of the book. MAJER considers the beeches with yews (*Taxo-Fagetum bakonyicum*) as an association between the submontane beeches with hornbeam and the karstic beeches (*Fago-Ornetum*); its lower layer is more or less dense yew-wood; these develop where the competition by beech slows down. — Comparison and classification into plant geographical frameworks are presented by the survey of yew tree in Europe and in other continents. The author holds the view that *Taxus* of Europe can be distinguished by 11 geographical regions, and one of them is that of the Bakony mountain. — The chapter describing the tasks of nature preservation is built on the original studies related to the wood production of wood stand as well as to natural forest reproduction and forest cultivation. — The closing chapter of the book demonstrates the role of yew trees in Hungarian ornamental garden cultures.

Even if we do not have satisfactory evidence of the time of origin of the Bakony stands of the *Taxus*, they undoubtedly imply a relict situation. In this respect, in my opinion — having studied the plant associations of the area at issue on several occasions — the beeches mixed with yew trees lie in that zone of the Bakony mountain where the vegetation-historical relicts occur in the greatest number, which is related with the dolomite phenomenon known in the Hungarian Central Mountain Range and described for the first time by B. ZÓLYOMI in 1942. These species are mainly survivors of the glacial period: *Primula auricula*, *Allium victorialis*, *Rubus saxatile*, *Calamagrostis varia* etc., and are topographically situated within such a zone that marks the meeting of striking contour between two vegetation zones, viz. the subatlantico-submontane beeches (interwoven with illyric species) and the xerothermophylous submediterranean oaks. This border situation where the plant communities of both

zones only develop under special conditions weakens the competitive ability of the populations, and creates favourable conditions for the relicts. The yew tree itself is also a member of the *Fago-Ornetum* association which preserves relicts (ZÓLYOMI 1950). The spatial contact between zones of beeches and of xerothermophylous oaks is an illyric — thus Western Balkanic — phenomenon (FEKETE—ZÓLYOMI, Ann. Hist.-nat. Mus. Nat. Hung. 1966); it is not by chance that the yew forests mixed with lindens in NW-Croatia floristically stand near to those of the Bakony, as is pointed out by A. MAJER in his book. It is to be noted that in a fartherlying area of Hungary, in the Bükk Mountain (Northern Hungarian Central Mountain Range), *Taxus* grows also in beeches in herb layer with *Sesleria*, which is related to *Fago-Ornetum*, a community also of a relict character; here we can even mention as a shortcoming that the Author has forgetten to mention the stands of the Bükk Mountain — even though they are small in number.

The structure and division of the book are good, and assist in surveying of the subject, which in many respects surpasses local implications. The figures illustrate the text well. The photographs would also be satisfactory if the printing techniques and layout in most of them were not so weak.

Let me mention here that a study in English containing the botanical-ecological results of the book was published not long ago in the columns of this periodical (Acta Botanica 26, 1980).

We can recomment A. MAJER's book: The yews of the Bakony, to either botanists, ecologists, foresters, gardeners or preservers of nature.

G. FEKETE

ELLENBERG, H.: Vegetation Mitteleuropas mit den Alpen in ökologischer Sicht. 1978. 2. Aufl Verlag Eugen ULMER, Stuttgart. 981 pp., 499 figures, 130 tables

This is a second enlarged edition of the book published in 1963 presenting an extremely good surveying not only of the vegetation of Central Europe but also the results of research that have been achieved in the framework of IBP and of MAB programmes, in coenology, ecology and environmental protection.

With consideration of the ecological foundations, a detailed and accurate description of the vegetation of Europe is presented supported by well-designed and easily surveyable coenological tables.

The book is divided into five main parts. In the introductory part (Chapters I—II), historical characterization of the vegetation are to be found. Human activity which has produced the vegetation of Europe today is described thus, the farming effect of forest clearing, grassland and meadow as well as fiel cultivation, and technical and industrial activities. The latter has been an increased burden on the environment. As a result of the multi-directional burdening of the environment, the ecosystem has undergone changes, and the relationship between plants, animals and men within the ecosystem has also changed.

The second main part (Chapters I—V) deals with natural forests and shrubs, thus, with beeches, beeches mixed with oaks, lindens, thermophilous oakwoods, acidophilous forests, as well as with the woody vegetation of alluvion, marshes and bogs. A comprehensive picture of the forests of Central Europe with their vertical and horizontal zonations is given as well as the ecological characteristics of more important, forest-forming wood species, and the soil conditions determining the formation of the herb layer. The plant species classified into various ecological groups are good indicators of the habitat conditions.

A detailed coenological, floristical and successional characterization is presented with regard to the individual forest associations. The research results related to the production conditions, nutrient cycle in the various forest zones of Europe, assigned to the sampling areas of the IBP framework are also given. The soil conditions of the various forest associations are characterized in detail and so are the nitrification dynamics of the soils, as well as the effect of fertilization on the acidophilous forests.

Assuming a complex approach a table has been compiled on the more important and characteristic animal species of the individual forest associations, too.

The third main part (Chapters I—VIII) contains mostly the near-nature formations the vegetation of fresh waters, and their shores, of flushes bogs saline and alkaline soils, sanddunes as well as the above-forest zones of high mountains and alpine areas, and the vegetation of the nival zone, and also the epiphyton vegetation (algae, lichen, moss).

The conditions of nutrients in various aquatic types, as well as the characteristic submerged aquatic plant associations, reeds and high sedges are described. The physiognomical-

ecological bog types of Central Europe are surveyed at length. The description of the individual bog types is supplemented with an extremely illustrative collection of figures.

The origin and the ecological characteristics of the European halophilous plants are also reviewed.

A description of the various dune types and their succession relations can be found, too.

Owing to the mosaic-like habitat patterns, the vegetation mosaics are characteristic of the subalpine region. The spread of the plant associations in the alpine region depends to a great extent on the duration of the snow cover on the soil.

The fourth main part (Chapters I—X) deals with formations established and maintained chiefly by man.

Here belong the dry and semi-dry meadows of the colline and montane regions; dwarf-scrub (Heide vegetation), the various forest plantations, forest-cultivations, clearing vegetation, edge-associations, shrubs, hay-meadow, marshy and drying-out bog grasslands, fertilized grazing fields, associations tolerant to being trodden.

The short-lived, fenwood-inhabiting Nanocyperion, as well as the nitrophilous associations in the shores of standing- and fresh waters become organized as a result of human activity. A separate chapter deals with ruderal vegetation and with the weeds of fields, gardens and vineyards as well as with the succession relations of fallow lands.

In the last part, a 55-page list of references can be found, for further orientation for the reader, but representing at the same time the enormous source material used by the author in this book so as to give the full scope of the vegetation of Central Europe.

A bibliography provides a survey of the titles on the vegetation of individual geographical regions.

A picture of the vegetation units (class, series, group) and the characteristic species completes the survey.

The register of the species dealt with in the book is very useful. Along with the Latin and German name of the plant, the reference or the page numbers to the relevant tables (where the species is mentioned), as well as the decimal number on the basis of which the species can be found in the coenological register (the coenological group in which it occures), the number indicating the ecological characteristic value of the species (light, temperature, continentality, humidity, sulphur effect, nitrogen, alkalization), and the life-form are all contained in the reister of the species.

A specialized register completes the book.

This basic work is comprehensive survey of the whole plant world and its ecological conditions in Central Europe.

M. Kovács

Grime, J. P.: Plant strategies and vegetation processes. John Wiley and Sons, Chichester, New York, 1979, 222 pp.

Many research workers have been concerned with finding out the processes which develop and control the structure and species composition of vegetation and/or cause the change of this composition from place to place. Much information has been collected, and there have been several approaches (e.g. correlative, direct, comparative, etc.) to solve these problems. The author stresses the recognition and study of adaptive strategies evolved in plants. These strategies refer to the processes determining the composition of vegetation. The author's merit is that he tries to elaborate a uniform concept of strategy applicable in plant and animal ecology.

The book consists of two parts, both with three chapters. The first part is devoted to the different plant strategies in established and regenerative phases. The second part is concerned with vegetation processes. The book closes with an abundant reference list of twenty pages. An index of names of plants and animals mentioned in the book, as well as a subject index can be found at the end of the book.

The first chapter deals with the primary strategies by which a plant in an established phase may adapt to its habitat conditions. The external factors limiting plant biomass may be classified into two categories, stress and disturbance phenomena, and there are two levels of intensities, high and low. From their combinations four types of habitats may conceived, habitats with low stress and low disturbance, with high stress and low disturbance, with low stress and high disturbance, and high stress and high disturbance. Only the first three are viable as plant habitats, and accordingly three primary strategies (competitive, stress-tolerant, and ruderal, respectively) have evolved in plants during the evolution by selection. These are, of course, extremes of evolutionary specialization.

The author tries to define the concept of competition, stress and disturbance more closely, and considers some evidence for their existence illustrated by several examples.

First the competitive strategy is reviewed. The competitive ability of a plant species may vary according to the conditions in which it grows. On the basis of several investigations the importance of competition seems to be comparatively smaller in the unproductive habitats than in the productive ones. The competitive characteristics (such as high dense canopy of leaves, a large root surface area . . .) may be influenced by forms of stress and disturbance but these attributes may also be subject to genetic variations (cf. intraspecific variations in competitive attributes).

The stress-tolerators have another strategy which enables adaptation to various intensities of stress (e.g. stress-tolerance against desiccation, shading, nutrient deficiency). On the basis of the responses to heavy shading it seems that energy is spent by shade-tolerant species for survival and not for maximizing light interception. In the background of this ability is "the evolution of mechanisms of conserving energy rather than those which increase the quantity of energy captured". The stress-tolerance in nutrient-deficient habitats has been most closely examined from both agricultural and ecological respects. The book contains references to natural selection which plays an important part in adaptation to the low concentration of nutrient supply, too. We can read about interesting examples of stress-tolerance by organisms living in symbiosis-lichen, ectotrophic mycrrhizas, and interesting examples are also mentioned of the relationship between stress-tolerance and palatability.

Ruderal vegetation develops in habitats subject to frequent and severe disturbance. Low vegetation density may occur not only in the unproductive habitats but also in the productive ones where partial or total destruction of vegetation is caused by disturbance.

The responses of plants to environmental variations differ according to their strategies. The responses of competitors gare generally morphogenetic and those of stress-tolerators physiological. The conclusions at the end of this chapter contains the theory of C-, S-, and R-selection which are three different forms of natural selection during the evolution of plants. Three different types with crucial genetic differences may be characterized by three different responses to stress and three types of life history (this of course is simplified). Several characteristics of competitive, stress-tolerant and ruderal plants are summarized in well-arranged tables. The author tries to reconcile the concept of primary strategies with that of r- and K-selection and points out the difference, too. In view of the evidence it appears that there are analogous strategies in fungi and in animals which correspond to those recognized in green plants.

As it has been mentioned the three primary strategies are the extremes of evolutionary specialization. In nature various secondary strategies have also evolved corresponding to the intermediate intensity of competition, stress and disturbance (Chapter 2). A linear arrangement does not encompass the full range of variations existing between competition, stress and disturbance, therefore the application of a triangle model is necessary. Four main types of secondary strategies are distinguished (competitive ruderals, stress-tolerant ruderals, stress-tolerant competitors, and C—S—R strategists). Their existence is confirmed by both field and laboratory investigations. These types are illustrated in detail with accounts of their general characteristics and the habitats where they occur. The life cycle of species is emphasized, more exactly attention is drawn to a delicate balance between the established and regenerative phases. Supposing that the triangle model indicates the relationship between strategy and life form, that is it describes "the approximate strategic range of selected life forms" then it can be accepted that it would provide a basis for classifying plants and vegetation types in this manner. It is demonstrated by an example based on two criteria (morphology index and maximum rate of dry matter production). The author discusses investigations carried out on the subject of intraspecific variation with respect to strategy. It is clear from the studies that there are populations of species which differ considerably in life-cycle in relation to the effects of various environmental conditions.

Plants have an enormous variety of mechanisms for regeneration (Chapter 3). Exclusively vegetative regeneration does not make the survival of plant populations possible during extreme environmental changes. Therefore generative reproduction has great importance as seeds involve numerous features for survival. Plants have certain basic forms of regeneration which may be classified, more or less arbitraryly, into five types. The characteristics of each type are described in detail (where they occur more frequenty — in which region; which life-forms are very common among them; what are the advantages of form with regard to the fluctuations or changes in environmental factors). The role of animals in plant regeneration is not negligible (seed dispersal, damage of seeds of seedlings). The same population may have multiple regenerative ability as is illustrated in several instances. The effective regeneration depends on all factors (both physical and biotic) which determine and/or influence the

regenerative capacity by its restriction or inhibition. It is obvious that the chance of survival differs between those species with one, and those with more than one regeneratives. The species of multiple regenerative capacity can be adapt more easily to changing conditions, altering the relative effectiveness of their various regenerative mechanisms. In the conclusions of this chapter the strategies in the established and regenerative phases are combined, and there are a few words about the breeding system of annuals and perennials, too. There is also information on regenerative forms in fungi and animals.

The next three chapters (Part 2) deal with the vegetation processes. First the nature of dominance is discussed. In this respect the basic question is how the dominant plants can exert an influence on their surroundings, especially on their smaller neighbours, and how these latter can tolerate stresses caused by the dominants. Interesting examples are enumerated illustrating the effects of litter of dominant trees on herbaceous plants and shrubs. The regenerative capacity as a function of dominance is also reflected in the different adaptations to physical conditions, predation, microbial attack, and allelopathic ability including autotoxicity. Analogous phenomena are mentioned among animals. During the development of vegetation in productive habitats the dominant plants of various strategies replace each other (e.g. competitive dominants will be followed by stress-tolerants). It is already part of the processes of succession.

Chapter 5 is concerned with succession, but mainly secondary succession. Two kinds of changes in vegetation may be distinguished broadly, those which are successional and those which are cyclical. In both vegetational changes the plant strategies in different life-cycles (established and regenerative) can be examined. Attention is drawn to the relationships between plant strategies and life-forms in successional changes. Moreover these provide a basis "to explain the various sequences of plants observed in secondary succession". A simple model of vegetation succession is created based on the potential productivity of the habitat, and is basically the same as that previously considered in Chapter 2. It may also be important to plant ecologists to analyse other feature of vegetation change such as "differences between early and late successional stages in rate of floristic change, in vegetation stability, and in species density".

The last chapter is devoted to a problem of particular importance — to the question of co-existance. With respect to this the processes which affect the species density under various conditions (including the mono- and mixed cultures, different environmental effects) should be followed. The results originating from numerous investigations are summarized in a general model which reflects relationships between five processes influencing the density of species in vegetation. This model can be applied to processes that take place both in disturbed and undisturbed vegetation.

This book is useful for everybody dealing with plant ecology or ecology in general.

E. Molnár

Miles, J. (1979): Vegetation dynamics. In Dunnet, G. M.—Gimingham, C. H. (eds): Outline studies in ecology. Chapman and Hall, London, 80 pp.

The book is a first issue of a series launched now with an aim — as expounded by the editors — to present short, concise insights into the individual fields of ecology. In this opening volume, J. Miles' intention is to survey in a concentrated way the difficult questions and aspects especially actual in our days of vegetation dynamism. His point of departure its that "long term stability in vegetation may be the exception, and episodic disturbance the rule".

The chapter titles are as follows: "The nature of vegetation; Processes of vegetation change; Fluctuations; Regeneration and cyclic changes; Primary successions; Secondary successions; Changes caused by grazing animals; Concluding remarks. On dwelling upon the nature of vegetation he unambiguously rejects its organismic view, nevertheless he accepts that if not for anything else only as a consequence of species interactions it is more than a mere mass of species and it has its own characteristics. Periodical changes are general and nourish from many sources. With respect to vegetation changes he thinks that a model does not function exclusively but several of them may function — successively or simultaneously — in the same site. The author differentiates between fluctuation and succession and remarks that the boundary between them is not sharp; fluctuation is reversible and of a short duration, while succession is directional and is often related to the settlement of new species. The stages of vegetation changes are discussed after Clements, although Miles does not consider the

role of site-modification very significant. He discusses the cyclic phenomena and those of regeneration with emphasis. The examples presented in connexion with discussing the pioneer and the secondary successions are instructive, whereas a more exact treatment of the process would require an outlook of a different type too; there is only a modest reference to these. The neglecting of aspects such as succession and diversity, succession and stability may be taken as shortcomings. The list of references is considerable (303 items are referred to) and useful just as the whole book in general is.

G. FEKETE

RORISON, I. H.—RODERICK HUNT (eds): Amenity grassland. John WILEY and Sons, Chichester—New York—Brisbane—Toronto, 261 pp, 1980.

Amenity grassland means all grassland which has recreational, functional, or aesthetic value, but which is not used primarily for agricultural production (NERC 1977).

Amenity grassland plays a great part in our everyday life, in the landscape gardening, and it is particularly important in developing of urban and recreation areas all over the world. Mainly in the UK there is a great past of intensive management of turfgrass, and active research of management, farming.

In 1978 a meeting, entitled "Amenity Grassland Research — An Ecological Perspective" was held at the University of Sheffield to discuss current knowledge, research activity in investigating amenity grassland, and especially the problems which have arisen recently and the needs for more extensive ecological studies for the sake of productive management and maintenance of grassland.

This book edited by RORISON and RODERICK HUNT contains the 14 main contributions to the above-mentioned meeting. The book serves not as a textbook, but it presents some problems debated concerning the gaps between research and employment. The aims of the contributions delivered at the meeting were to interchange ideas between turfgrass specialists, ecologists and managers, as well as to emphasize the importance of knowing and using ecological principles and investigating results in management.

The chapters can be divided into 3 parts with respect to their themes. They include the breeding and selection of plant material, the physical and chemical components of the soil and the use and maintenance of grasslands.

GRIME in his paper deals with the ecological principles for many of the forms of management. He presents some ecological surveys dealing with species composition of vegetation, spatial distribution, phenology and life history of plant species, as well as population dynamics of plants. In his opinion these ecological studies may lead to explanations of features of a plant's ecology and may provide an understanding of management. But he suggests another approach for vegetation management. It is the theory of plant strategies relating to both life histories and physiology and to the processes which control the structure, dynamics, and species composition of vegetation.

The method worked out by GRIME may be applied to almost all living organisms. Two main strategies of annual plants have been distinguished, which are determined by the characteristics of the established and regenerative phases. To mention some of the strategies GRIME reviewes in his paper 3 fundamentally different primary strategies in the established phase. These are the competitive, stress tolerant and ruderal strategies. Besides, for GRIME, four types of secondary strategies prevail in the established phase, that are the different combinations of the 3 primary strategies.

The gives a profound discussion on plant strategies of different types and at the same time providing number of practical suggestions for management.

In the chapter written by HUMPHREYS the importance of the ecological studies, which provides information on species artributes, ecotypic variation, including specific adaptations to environmental and user stress has been emphasized. HUMPHREYS points out that the breeders must pay more attention to the development of cultivars specifically for amenity use. The species that would be acceptable to users and producers must be tolerant to tapping, grazing, heavy metal, drought and many extreme or impoverished environmental conditions. HUMPHREYS presents the effect of salt, drought and heavy metal on the population of *Festuca rubra* in addition he summarizes some of the characteristics found in perennial ryegrass populations.

SHILDRICK's paper is principally about turfgrasses and turf mixtures for lawn. 16 turfgrasses are presented and the most important qualities for turfgrass in the UK, such as persistence under close mowing, durability under wear, disease tolerance, compactness, good

winter colour, slow vertical growth, cleannes of cut are shown in tables. It is interesting to see some adaptive cultivars mentioned in this article in the light of the information on maintenance costs.

The following 3 papers deal with nutrient supply and maintenance of nutrient levels of the soil, as well as different soil managements.

Bradshaw shows some experiments associated with various Al, Mn toxicity of species dry weight of grass species at varying levels of N and the long term effects of fertilizer treatment. The different growth responses to nutrients and the diverse adaptation to soils containing high levels of toxic materials and suffering chemical imbalance of some herbaceous plants are reviewed in detail. In Bradshaw's paper the adaptation of plants is presented mainly in terms of chemical factors.

In Sewart's contribution the problems of the adaptation of plants are discussed in terms of physical aspects, such as drainage and moisture supply. Besides, a number of plants adapted to dry sandy soil, duneland communities have been shown as well as plants of temporarily waterlogged area.

The third paper including soil problems covers the definition of wear in the English language and the best method of studying wear such as simulation of wear. Canaway writes that to wear can mean to damage or to change by use or to suffer damage or change, as well as wear can also mean the results of such action. In the paper written by Canaway the effect of human trampling and a number of properties of trampling tolerant vegetation have been analysed. To mention some of the properties, with which trampling tolerant plant species have been characterized, are small plant size, growth close to the ground, small leaves and rapid nutrient uptake.

The roles of each of the major management tools, mowing, growth control via herbicides, growth retardant, burning and grazing are demonstrated in 5 papers.

Green in his paper describes the results of an investigation relating to the timing, frequency and height of cut.

Parker debates many of the management problems and costs of mowing. He pays great attention to giving useful technical information and ways of treatments. The advantages and disadvantages of mowing are summarized in Wells' paper, too. Mainly 3 questions concerning cutting are discussed. They are in what situation mowing should be used and the removal of cut material is either desirable or necessary, as well as what happens with nutrient pool after cutting, removed vegetation. Wells presents also the differences between the grazing animal and the cutting machine and deals with the problems of frequency and intensity of these operations. We stress the usefulness of the part of Wells' article, in which the advantages and disadvantages of cattle, sheep, deer and horse grazing are summarized together with suggestions for the kind of situation in which they might be used. And we have also to say, that besides debating on the major management tools Wells deals with the ecologica basis of grassland management which has to be taken into account by the managers.

The employment of herbicides in amenity grassland is a relatively new method. However amenity grasses are slower to establish than agricultural grasses, so weed control may be more important in turfgrasses. Haggar's chapter has demonstrated the many possibilities that now exist for regulating sward composition. A number of selective herbicides are given which could be applied to amenity grassland, as well as some resisting species and problems in controlling species composition.

Finally at the end of this book we can find two overviews.

Snaydon's overview about the ecological aspects of management and a perspective is especially remarkable. The author provides a thorough discussion on the ecologist's and the agronomist' different viewpoints and their different approaches to the study of plant communities. Snaydon emphasizes the importance of ecological principles in management but indicates also those aspects of management where ecological results and formulations are not relevant. He points out the danger of the great gaps between theoretical ecology and essentially practical or applied ecology and between the ecologist's empirical and the manager's pragmatic approaches.

This book including a lot of illustrative examples, tables and figures will be interesting and useful both to the specialists concerned with amenity grassland and also to the ecologists.

K. Virágh

RAMADE, F.: Élements d'écologie appliquée. 2nd ed. McGRAW-HILL Inc. Paris, 576 pp, 30 tables and 226 figures

The work containing the biological and ecological implications of environmental protection is primarily a textbook prepared for university students. Providing an abundant new store of knowledge, it is very useful for environmentalists dealing with ecology and environmental protection and nature preservation.

Part one of the book divided into three main parts deals with the structure of the biosphere, and evolution with (Chapters I—II). Macro-ecosystems, their horizontal and vertical zonation, material and energy flow, as well as the biogeochemical cycles of water, carbon, oxygen, nitrogen and sulphur are discussed in detail.

The notion of primary and secondary production, the ecological-, biomass- and energy pyramids, and energy cycling in the ecosystem are treated in detail too.

In the framework of the degradation of the biosphere, the effects caused by agriculture, industry and demographical explosions are described. The second main part os the book is divided into five chapters (III—VII), and is a direct continuation of the firest part presenting in great detail the ecological basic notions elaborating on the pollution of the biosphere and its ecological consequences.

The gaseous and aerosolous polluting materials of the air affect the chemical composition of the evaporation and the soil. The harmful effect of certain polluting materials, as for example that of lead, extends to the whole of the biosphere. The polluted atmosphere has a noxious effect on the ecosystems, on the climatic conditions of the Earth. As a result of intensified energy consumption of the cities, the average temperature of the cities also increases. Numerous examples and data have been given to demonstrate the changes caused by increased atmospheric pollution and energy consumption in the climate of various areas on the Earth. In consequence of increased pollution of the atmosphere changes have also taken place in the biogeochemical cycles, especially in the oxygen cycle. The harmful effect of S, NO, F, O_3, Pb can be measured from the reactions of the plant and the animal kingdom as well as that of man.

Modern agriculture, which is the main cause of soil pollution, with its increasing doses of fertilizing agents disturbs the biogeochemical cycles of nitrogen and phosphorus. The direct and indirect effect of pesticides on the species of biocenoses is also discussed in detail.

The biological, chemical and thermal pollution of continental and oceanic waters has several negative ecological consequences, for example the oxygen content of waters undergoes changes, and certain chemical materials in the living organisms may become enriched. In the neighbourhood of atomic works, thermal loading and their effects (changes in the temperature of waters, and in their O_2, CO_2 and Ca content) have to be reckoned with. A separate chapter deals with the ecological effects of pollution caused by atomic works and with the radio activity susceptibility of living organisms.

In Part Three (Chapters VIII—X), the increased exploitation of natural resources, and boundaries of the biosphere are discussed. The extent of the destruction of the vegetation on the Earth, and the decrease in the forested areas on the various continents, has come to cause anxiety. As a consequence of unacceptable agricultural practices the soils have been: physico-chemically destroyed salinization, laterization (in tropical areas), and erosion have ensued.

With the destruction and repression of natural vegetation, its the various animal species are dying out. Alarming examples are given of the rapid decrease in animal species living in different areas of the Earth, of the causes of defaunation and exhaustion of the wealth of the sea. Data are given and prognoses made on the energy mineral wealth, water and nutrient supply of the Earth, and the limits of energy resources of the biosphere. Moreover, the nature protecting measures for the prevention of harmful effects on the biosphere and on ecosystems are reviewed.

The book provided with an abundant literature, glossary of the more important terminology as well as with the register of technicalities and taxa make this comprehensive work one of the best handbooks of the past 10 years in applied ecology and environmental protection.

M. KOVÁCS

Green, R. H.: Sampling Design and Statistical Methods for Environmental Biologists. J. Wiley and Sons, New York. 1979. 257 pp.

Environmental biologists very often ask the Statisticians' advice after having completed the field work and data collection. Unfortunately, the statistician is not always able to give his best help since the data are inappropriate for mathematical analysis. In worse cases, the biologist simply throws his massive data sets into the most easily attainable computer package programs without any hypothesis formulation and adequate mathematical model. Such undesirable situations may be avoided only if environmentalists are familiar with the basic principles of sampling design and statistical analysis. However, this topic is covered in a rather diverse literature which is often inadequate for a nonstatistician. The book by R. H. Green, who is associate professor at the University of Western Ontario, London, Canada, was written to meet the long-felt need for a concise guide to the statistical methods applicable to the problems arising in environmental studies.

First, on the title which suggests "... methods for environmental biologists". One would think that this book covers the entire field of environmental biology including the study of terrestrial ecosystems. I feel, however, this title is too general, because the content of the book seems rather unbalanced. Almost all examples refer to aquatic environments, the methods are usually illustrated by benthic studies. The bibliography contains 180 references related to freshwater and marine environment whereas only 50 publications are cited from terrestrial ecology. Although the applicability of statistical methods mostly does not depend on whether the environment is aquatic or terrestrial, in my opinion the title does not perfectly reflect the actual subject of the book.

Nevertheless, I have no further substantial objections. I think Prof. Green's intentions outlined in the Introduction have been fully realized. It is an excellent guide to the principles of sampling design and data analysis. This is not a statistical cookbook although several methods are illustrated by examples based on simulated data and even the computational steps are described in a few cases. The author presents a comprehensive "review of reviews" and gives many citations of methods, computer programs and actual examples.

The well-structured book is divided into three major sections: Principles, Decisions and Sequences. These are preceded by the Introduction which outlines the purpose of the book and describes its organization.

The Principles section contains three chapters. In the first a general review is given on statistical analysis and hypothesis formulation. There are some examples to show the importance of effective presentations of raw data. It is emphasized that "... nothing is worse than inappropriate or unnecessary use of statistics. Graphical or tabular data formats ... can stand on their own." Problems arising from the interpretation of results, e.g. computing artifacts and confounding variables, are also discussed. In the second part of this section a simple example is presented to illustrate ten basic principles of sampling design and statistical analysis which are discussed in the third chapter. These principles comprise the main ideas of the author on sampling and hypothesis testing. These are worth mentioning at least in brief: 1. State the problem and hypotheses precisely. 2. Take replicate samples. 3. Take an equal number of randomly allocated samples for each combination of controlled variables. 4. Take samples on control areas. 5. Carry out some preliminary sampling to check out serious problems before planning the sampling design. 6. Make samples in unbiased manner as much as possible. 7. Use stratified random design if large-scale environmental pattern occurs in the study area. 8. Use appropriate sample unit size and sample number. 9. Transform the data appropriately or use nonparametric procedures if certain statistical assumptions are not satisfied. 10. If a result is unexpected or undesired, do not reject the method or do not hunt for a "better" one.

The Decisions section describes the spatial-by-temporal framework within which an environmental study may be defined. The author presents a decision key to the five main sequences of sampling and statistical analysis in environmental studies. This section provides a broad overview of specific decision areas involved in an environmental study. These are: choice and form of variables, estimation of necessary sample size and sample number, data screening before analysis, computer programs and visual display of results.

The five main sequences are discussed and illustrated by examples in the Sequences section. These sequences are established on the basis of the prerequisites for an optimal design. If an optimal impact study design is not possible we have three suboptimal designs, when 1. impact is inferred from temporal change alone or 2. the impact is inferred from spatial pattern. The third suboptimal design is the baseline or monitoring study. The last sequence represents the worst possible situation when we are without knowledge of when and where the impact first occurred.

The Sequences section is followed by a vast bibliography containing about 530 items. It is cross-referenced to the text and keyed to a specific topic code according to the types of methods and environments studied. The book is supplied with a relatively short subject index.

In conclusion, this book is written in a simple, straightforward, lucid, and comprehensible style. It is of particular interest to all practicing environmentalists, especially to hydrobiologists, but the book is valuable reading for those biologists and statisticians who want to get an insight into a very important interdisciplinary field.

J. PODANI

S. E. JØRGENSEN (ed.): Handbook of environmental data and ecological parameters. International society for ecological modelling, Copenhagen 1979, 1162 pp.

The results of a great undertaking, which is new even as a genre, can be welcomed in this book. Its publication is justified as is written in the Introduction by the Editorial Board: "If one is dealing with environmental problems, such as preparation of environmental assessments or building ecological models, there has not been any handbook available, which gives information on the relevant ecological-biological parameters. We propose to fill this gap by 'Handbook of environmental data and ecological parameters'."

This handbook consists of 7 parts. Part A. Composition and ecological parameters of living organisms. Here the emphasis is on living organisms; and we can find the concentration data, on chemical compounds and elements as well as characteristic proportions, growth and mortality rates, the parameters of physiological functions; all these according to taxonomical or functional groups.

Part B. The ecosphere and chemical compounds. This chapter includes the element cycles and general properties of chemical compounds in the ecosphere, as well as pollutants, as the natural compounds. The Biological half-life time of various materials is touched upon and also such important titles as light-absorption, spectral characteristics, physiological effect, etc., the ecosphere and production, finally, various thermodynamical values.

Part C. Biological effects. This part covers the biological effect of chemical compounds and the physical environment, including toxicological data considered the most important from ecological points of view.

Part C. Chemicals and the living organisms. This chapter contains information on chemical compounds related to species (background concentrations, concentration factors for plants, animals, intake or excretion rates etc.).

Part E. Equations for biological processes.

Part F. Equations for chemical-physical processes in the environment.

Part G. Processes in the environment (absorption and activity; atmosphere: emission and release; diffusion and dispersion; equilibrium for chemical processes in the environment; stochiometric ratio; temperature coefficient and turnover time of processes in the ecosphere).

The above Parts are followed by the enumeration in Latin—English and English—Latin of the names of the organisms included in the volume. All these are closed with a very-detailed and well usable subject index.

The great number of literary titles (1779) — published mainly after 1970 — demonstrates well both the enormous amount of work put into the undertaking and the wide range of the working foundations. In spite of this, it would be easy to make suggestions for supplementations, or to call attention to some literary data which are considered important; we do not do this, nevertheless mention should be made in the columns of this periodical that the handbook neglects the Hungarian results which at the very time of this issue, and especially following the completion of the IBP, are of a considerable number. However, such a work can never be complete, therefore, with respect to the supplements we must welcome the promise of the editorial board that it is intended to update the handbook every 2—4 years.

The Handbook of environmental data and ecological parameters should not be missing from the library of any experimental ecologist.

G. FEKETE

ENGEN, S.: Stochastic abundance models. — CHAPMAN and HALL, London 1978, 126 pp.

The book providing an excellent survey of the topic is divided into two parts. The first deals with the theoretical bases, and the second with ecological applications. To understand both parts requires a well-founded familiarity with mathematics.

The expression abundance model is used in a broader sense here than is usual in the literature on ecology. The mass of elements (for example, individuals), when each of the elements belongs only to one class (category) refers to population. The ratio of elements occurring in the various classes constitutes a vector (p). The main aim of applying the abundance models is to study and analyse vector p when the classes are numerous.

The author describes several models and enumerates the viewpoints useful when having to choose from among the various models. At the same time he demonstrates that models based on theories differing from one another can be verified from one and the same observation series.

In the part discussing ecological applications, the author emphasizes the necessity of an ecological interpretation of fixed and random models. He raises the problem of estimating the goodness of fit, in connexion with which he presents a very illustrative example. He uses this example to point out that the same observation series can be described by means of models (four models) differing from one another.

The book is recommended to all researchers dealing with cenology.

The layout of the book is excellent which we are accustomed to from these publishers.

I. Précsényi

Horn, D. J.—Stairs, G. R.—Michell, R. D. (eds): Analysis of ecological system. — Ohio State Univ. Press, Columbus, 1979, 321 pp.

The proceedings of the colloquium on biological sciences held in 1977 by the State University or Ohio contain the material of 9 lectures. The word ecology was used at the colloquium in a wider sense.

Lewontin held a lecture on fitness, survival and optimality from the viewpoints of evolutionary ecology. The essential structure of a site ecologists' work and its relationship with the Darwinean theory is discussed by Mitchell and Williams. Embree deals primarily with the ecology of colonising animals and points out that the successfully settling species have a great influence on their environment and often beyond man's control. The study of Pianka—Huey—Lawlor on niche segregation is related to resource partitioning, overlap and competition. Of their statements especially those are worthy of attention which enable us to draw general inferences as e.g. that the non-random utilization of nutrient resources reduces the overlap therefore the partition of the nutrient resources becomes easier; or that there is a reversed relationship between overlap and species number. The developments in the theory of analysing interactions between plants and animals are discussed very thoroughly and interestingly by Gilbert. In the last 10—15 years, the attention of botanists and zoologists in various countries has turned to the nutrition of animals. They study not only the relationship between prey and animal of prey but also that between plant-feeding animals and plants. This topic is presented by Orians and Pearson. A largescale survey of quantitative ecology is given by Miller. In that survey, also the quantitative examinations beyond the trend of Goodall and Greig-Smith — which is already considered as classical — are also included. Wiegert's paper deals with population models as experimental instruments used in analysis of ecosystems. The ecology and biological control of *Hymenoptera*, damaging alfalfa, is discussed by Horn and Dowell.

The layout and printing of the book is fine. The text is lucid in a flowing style the figures are illustrative. References are to be found at the end of each paper and there is also an index.

I. Précsényi

CONTENTS

ACTA BOTANICA

КСИЛОТОМИЧЕСКИЕ ИССЛЕДОВАНИЯ НЕСКОЛЬКИХ КУБИНСКИХ ДРЕВЕСНЫХ ВИДОВ III

К. БАБОШ, А. БОРХИДИ

В третьей статье серии исследований авторы публикуют данные по морфологическим исследованиям внутренней анатомии ствола древесных видов: *Cordia Sebestena* L. (*Boraginaceae*), *Guazuma ulmifolia* LAM. (*Sterculiaceae*) и *Quercus oleoides* CHAM. et SCHLECHT. ssp. *sagraeana* (NUTT.) BORHIDI (*Fagaceae*).

СВЯЗЬ МЕЖДУ РЕДУКЦИОННЫМ ОРГАНИЧЕСКИМ МАТЕРИАЛОМ И ВРЕДОМ, ПРИНОСЯЩИМ ГЕТЕРОТРОФНЫМИ ФИТОФАГАМИ КУСТАРНИКУ ACER CAMPESTRE

Ч. БЕРЕШ

На образцовом участке дубового леса МАВ *Quercetum-petraeae-cerris* кустарник *Acer campestre* является доминантным видом. Листья этого кустарника весной сильно поедаются гетеротрофными листовыми фагами. Автор исследовал концентрацию редукционного органического материала в 1978 году. Для пробных образцов автор выбрал те кустарники, которые гусеницы не грызли (тип а) и кустарники, которые были сильно изгрызаны (тип б). В последних анализировали три типа листьев: в изгрызанных кустарниках листья, оставшиеся нетронутыми ($б_1$), сильноизгрызанные остатки листьев ($б_2$), а также молодые побеги, которые начали расти во время съедания гусеницами кустарников ($б_3$). Автор определил, что низкая концентрация фенолов и полифенолов наблюдалась в цельных листьях изгрызанных кустарников, а также в остатках листьев в противоположность с не сгрызанными с сгрызанными листьями молодых побегов. В главный период грызения гусеницами кустарников, концентрация фракции свободного сахара легко используемое как питательное вещество, показала обратный порядок. Эти два факта подтверждают предположение, что гетеротрофные фитофаги не случайно повреждают разным способом особи кустарников одного вида. Они предпочитаюг тот кустарник в котором значение свободных сахаров выше, и в то же время концентрация фенолов и происходных фенолов ниже.

КУБИНСКИЕ RUBIACEAE, I. И RANDIA L. И SHAFEROCHARIS URB.

А. БОРХИДИ

В статье автор описывает виды, которые являются представителями родов *Randia* L. и *Shaferocharis* URB. семейства *Rubiaceae* на Кубе. В работе, составляющей 33 печатные страницы, кроме аналитических ключей к кубинским видам двух родов, дается и их описание. Автор на основании исследованного материала поправляет описания и экологические данные видов обсуждает вместе с их географическим распространением. Автор подробно излагает проблему полиморфного вида *Randia aculeata* L. среди описания 4 новых видов можно найти следующие: *Randia costata* **BORHIDI n. sp.**, *Randia cubana* **BORHIDI n. sp.**, *Randia acunae* **BORHIDI n. sp.**, *Shaferocharis villosa* **BORHIDI et BISSE n. sp.**

ПРИМЕНЕНИЕ ХРОНОЛОГИЧЕСКОГО ПОРЯДКА И ДАННЫЕ ПОПЕРЕЧНОГО СЕЧЕНИЯ ПОПЕРЕЧНОЙ КОРРЕЛЯЦИИ В ИЗУЧЕНИИ ПРОДУКЦИИ

А. ЕОРИ, И. ПРЕЧЕНЬИ

В обмене веществ растительных сообществ важную роль играет турновер, время и отношение прохождения питательных веществ от одного компартмента к другому (зеленые части растения, ветощь, подстилка). В статье авторы исследуют новыми методами время перехода ветош в подстилку и также;константу потока. Позитивная корреляция поперечного сечения не только пригодна для определения запаздывания постоянной времени, но и для оценки константы потока в процессе образования подстилки. Авторы определили, что в сообществе ***Artemisio-Festucetum pseudovinae*** время перехода ветоши в подстилку 2 или 5 месяцев. Два месяца, которые были получены при поперечной корреляции хронологического порядка не отражает полного процесса, который значителен и для пятого месяца. Константа потока, к = 0,0036 (1) месяц.

СОДЕРЖАНИЕ ЭЛЕМЕНТОВ В ЛИСТЬЯХ НЕСКОЛЬКИХ ЛИСТОПАДНЫХ ДЕРЕВЬЕВ И БИОЛОГИЧЕСКАЯ ИНДИКАЦИЯ ТЯЖЕЛЫХ МЕТАЛЛОВ В ПРОМЫШЛЕННО-ГОРОДСКОЙ СРЕДЕ

М. КОВАЧ, Я. ПОДАНИ, Р. КЛИНЧЕК, М. ДИНКА, К. ТЕРЕК

Авторы исследовали содержание элементов (**Ca, Mg, K, Na, P, Fe, Sr, Mn, Pb, Zn, Cu**) в городской-промышленной (Будапешт) и деревенской (Вацратот) среде. Листья древесных видов в результате загрязнения воздуха накопляют в 1,2 – 9 раз больше тяжелых металов и различных олиго-элементов в городской среде, чем в деревенской. ***Robinia pseudoacacia*** является биологическим индикатором **Mn** и **Pb** а ***Tilia tomentosa*** — **Sr**, **Zn** и **Pb**. Была изготовлена карта олиго-элементов и карта нагрузки тяжелых металлов одного из промышленных районов Будапешта на основании накопившихся элементов в листьях мониторных растений.

БАКОНЬ-СЕНТГАЛЬСКИЙ ТИСОВЫЙ БУК ОВНИК

А. МАЙЕР

Тис, ***Taxus baccata*** L. «вымирающее» и нерременно вытесненное растение растительного мира Европы. Тис произрастает в венгерской средне гористой западной части Бако ни всего на 287 гектарах, и дает эдафитный мезоклиматический реликт. 120 тысяч деревьев и 600 м² древесной массы, произрастающей на этой территории являются одним из самых заповедных кладов венгерских лесов.

Автор на основе изучения 66 опытных участков растительного сообщества характеризует 6 ассоциаций этой площади на карте и на схеме поперечного разреза показывает их строение и распространение. В статье подтверждается, что баконьский тисовый буковник ***Taxo-Fagetum*** Moor 52, ***bakonyicum*** Majer 76 является самостоятельной естественной, внутризонной ассоциацией, достаточно бедной видами, гомогенной, со своеобразным составом и единственном в своем роде лесным сообществом. Баконьский тисовый буковник растительно-географически тесно связан с южными в основном хорватскими липово-тисовыми лесами.

КЛАССИФИКАЦИЯ ВИДА IRIS НА ОСНОВАНИИ ГЕНЕРАТИВНЫХ ЗНАКОВ

Е. МЕЛКО

Автор изучала живые виды ***Iris pumila*** L. и ***Iris taurica*** Lodd., которые были собраны ею в Венгрии, на Кавказе и в Закавказье.

Автор на основании 50 измеренных генеративных знаков 60 растений, употребляя 'аггломеративный кластер анализа **Orloci**' установила, что ***Iris pumila*** L. представляет собой единый вид:

— *Iris pumila* L. не группируется по местам происхождения;
— не удалось доказать, что *Iris taurica* LODD. представляет собой особенный вид;
— этот анализ не показал существование 'инфра-специфических таксонов'.

Iris pumila L. — вид полиплоида (Soó 1973). Автор не проводила цитологических исследований а на основании знаков, взятых из различной таксономической литературы, она сделала новую переработку измеренных ею знаков на основании нового таксономического метода.

НАКОПЛЕНИЕ ЭЛЕМЕТОВ В ВИДАХ LIGUSTRUM VULGARE И CORNUS SANGUINEA РАСТУЩИХ НА ОКРАИНЕ ДУБОВОГО ЛЕСА QUERCETUM PETRAEAE-CERRIS

I. РАСПРЕДЕЛЕНИЕ ЭЛЕМЕНТОВ В КУСТАРНИКАХ

И. МЕСАРОШ, П. ЯКУЧ

Авторы статьи исследовали на венгерском участке МАВ в дубовом лесу и его окраинах (**Síkfőkút Project** Якуч 1973, 1978) концентрацию некоторых элементов (**N, P, K, Ca, Mg, Fe, Mn, Zn, Cu, Na**) во фракциях растений (лист, годичная ветвь, ствол, главный корень, корневые волоски) в 5—5 особях кустарников *Cornus sanguinea* и *Ligustrum vulgare* Авторы исследовали содержание элементов, извлекаемых растениями из почвы при помощи корневой системы, а также исследование их внутри растительной фракции. Материал был взят и обработан с трех площадей: из дубового леса с закрытой лиственной кроной, с северной окраины леса, с окраины леса, граничащей с сельскохозяйственной площадью, а также из бездревесной, окруженной сельскохозяйственной площадью кустарниковой местности. Авторы определили, что самая высокая концентрация элементов находилась в физиологически самых активных частях растений: в листьях и в корневых волосках. Относительно самая высокая концентрация макроэлементов (**N, P, K, Ca** и **Mg**) наблюдалась в листьях, а в корневых волосках в большой концентрации находились микроэлементы. Концентрация большинства элементов в стволе и в главном корне сигнификантно не различалась. Роль годичных ветвей и корневых волосков почти равноценна в накоплении элементов. *Ligustrum vulgare* соедржал все элементы, кроме **Ca** и **Mg** в более высокой концентрации чем *Cornus sanguinea*. Во фракциях листьев, годичной ветви и корневого волоска фактор концентрации элементов высокий. Было характерно, что внутри растений наблюдалось высокое обогащение элементами: **N, Fe** и **K** (10^{0}—10^{3}).

Несмотря на высокую концентрацию Ca в почве, расходование кустарниками Ca было слабое, а фактор концентрации Ca равнялся 10^{-1}—10^{0}.

ВЛИЯНИЕ ПОЕДАНИЯ ЛИСТВЫ ЛИЧИНКАМИ LEPIDOPTERA НА ЛИСТВЕННУЮ ПРОДУКЦИЮ QUERCUS PETRAEA (MATT.) LIEBL.

М. НАДЬ

Автор исследовала в 1978 году на образцовом участке дубового леса всязь между поеданием листвы дуба *Quercus petraea* (MATT.) LIEBL. личниками *Lepidoptera* и годовой лиственной продукцией. Автор проследила за образованием числа личинок, а также за количественным отношением погибших побегов в подстилке в результате поедания их личинками и за развитием молодых побегов и соотношением их в кроне листьев. В конце вегетационного периода на основании данных по 20 деревьям автор определила отношение фотосинтетической фитомассы побегов разного возраста, их расположение по ярусам и принятие ими участия в годовой первичной продукции. В 1978 году поедание *Tortrix viridana* причинило в первичных побегах 60—65% кумулятивный общий вред, в особенности в верхнем ярусе лиственной кроны. Для возмещения убытка причиненного листве, из спящих почек развились вторичные и третичные побели. Осенью в фитомассе 24,39% составляли первичные побеги и 75,61% новые побеги. Это количество, рассчитанное на индекс поверхности листа (0, A) равнялось 1.03 вернее 3.21, что соответствовало общему значению 4.24. По расчетам автора первичные побеги составляли 30—50% годовой первичной продукции, вторичные побеги — 50—70%, а третичные побеги, которые существовали самое короткое время составляли 0,5% продукции.

Дубовый лес *Quercus petraea* (MATT.) LIEBL. в естественных условиях может компенсировать средний вред, причиненный фитофагами.

ВЬЕТНАМСКИЕ МХИ II

Т. НИНЬ

Автор публикует данные о 25 видах мха, распространенных во Вьетнаме, среди которых *Calymperopsis vietnamensis* Ninh, *C. pocsii* Ninh и *Distichophyllum duongii* Ninh новые для науки. В статье описываются новые комбинации *Calyptrochaeta spinosa* (Nog.) Ninh и *Wijkia clastrobryoides* (Tix.) Ninh и распространение 6 новых для Ввтнама видов.

НОВЫЙ РОД NOGUCHIODENDRON ИЗ СЕМЕЙСТВА NECKERACEAE

Т. НИНЬ и Т. ПОЧ

Авторы на основании изучения индокитайских видов *Homaliodendron* ранее известный под названием *H. sphaerocarpum* Noguchi вид отнесли к новому роду *Noguchiodendron*. Отличительные признаки рода *Noguchiodendron* по сравнению с *Homaliodendron* следующие: в стволе находится центральный проводящий пучек, высохшее растение с обратнозакрученными как улитка побегами, спорангий (theca) почти круглой формы, экзотециальные клетки квадратные или изодиаметральные шестиугольные и не распределяются в углу, сегменты эндостомия волокнистые, недолгоживущие, с хорошо дифференцированным annulus и споры размером, больше, чем 20 μm. Наряду с описанием гового рода дается описание новой комбинации *Noguchiodendron sphaerocarpum* (Noguchi) Ninh et Pócs

ИССЛЕДОВАНИЯ АФРИКАНСКИХ CALYMPERACEAE КОНСПЕКТ АФРИКАНСКИХ ВИДОВ РОДА SYRRHOPODON

Ш. ОРБАН

Автор опубликовывает ревизию африканских видов рода *Syrrhopodon*. В статье даются новые синонимы и распространение видов. Новые данные, описанные в статье — это наличие африканских видов *Syrrhopodon gaudichaudii* и *S. gardneri*, таким образом первый вид показывает южно-американско-африканское распространение, а вид *S. gardneri* тропическое.

На основе ревизии число видов *Syrrhopodon* уменьшается с 60 до 23 видов.

СОДЕРЖАНИЕ ПРОЛИНА И ФЕРТИЛЬНОСТЬ ПЫЛЬЦЫ ИНЦУХТНЫХ ЛИНИЙ КУКУРУЗЫ

Г. ПАЛФИ, Л. ПИНТЕР, Ж. ПАЛФИ

Авторы исследуют содержание пролина в пыльце и его взаимосвязь с фертильностью пыльцы в 12 инцухтированных линиях кукурузы. Было определено, что высокое содержание пролина в пыльце связано с лучшей способностью пыльцы к оплодотворению. У линий кукурузы, в которых содержание пролино было 1,5 и 2,5%, пыльца была более жизнеспособна и фертильна. В заключении статьи авторы публикуют интересную теорию по которой, используя отцовские растения с высоким содержанием пролина, можно улучшить жизнеспособность потомства. Поэтому кажется перспективным селектировать новые линии по этим данным.

ИЗМЕНЕНИЕ РАЗНООБРАЗИЯ РАСТИТЕЛЬНОСТИ В СУКЦЕССИИ

И. ПРЕЧЕНЬИ

Автор исследовал во время облесения песчаной степи в процессе одной из серий сукцессии изменение разнообразия: род-вид, вид-относительное покрытие, жизненная форма-релативное покрытие. Самые низкие разнобразия наблюдались в сообществе закрывающем сукцессию (*Convallario-Quercetum roboris*). Разнообразие, вид относительное покрытие, меняется в вестационном периоде и в некоторых сообщесввах уменьшается с весны до осени. Растительные сообщества, которые представляют собой некоторые стадии сукцессии следуют друг за другом в таком пространстве-niche, осями которого служит содержание гумуса и влажность почвы, а также световые отношения.

ФЕНОЛОГИЯ И ПРОБЛЕМЫ ИЗОБРАЖЕНИЯ НЕКОТОРЫХ ВОСТОЧНО-СРЕДНЕЗЕМНОМОРСКИХ ГЕОФИТ

С. ПРИСТЕР

Автор в течение 10 лет проводил фенологические и онтогенетические исследования на 800 холодноустойчивых видах геофит. В данной статье автор, иллюстрируя восточно-среднечерноморскими таксонами перечисляет группы с различной теплоёмкостью и показывает новейший метод фенологического изображения. Фенограмма, состоящая из трех концентрических кругов служит простым и хорошо смотрящимся сравнительным эффектом: паралелльно показывает на протяжении одного года время стадии покоя, вегетативной и генеративной стадии каждого вида, а также продолжительность времени характерных фаз стадий по декадам или пентадам. Вместе с фенограммой автор публикует в виде образца рисунки онтогенетических фаз двух видов.

MONOCLEA FORSTERI Hook. НА КУБЕ

Д. РЕЙЕС МОНТОЯ

Местонахождение монотипичного семейства *Monocleaceae* новое для Кубы. *Monoclea forsteri* Hook. распространен в горных дождевых лесах и в насыщенных парами тенистых карстовых лесах до высоты 400—120 м. Карта иллюстрирует кубинское и общее распространение этого вида. Так как *Monoclea* по многим вегетативным признакам похож на космополитный, океанского распространения вид *Dumortiera hirsuta* (Sw.) Nees, авторы описывают в статье свойства различающие эти два рода.

ДОПОЛНЕНИЕ К ИЗУЧЕНИЮ ВОДНОГО РЕЖИМА ТИПОВ БУКОВЫХ ЛЕСОВ

И. СОДФРИДТ

Автор разделил на категории типы венгерских буковых лесов по их водному режиму; на этой основе их подразделили на 8 степеней. (Майер, 1956). Зачисление некоторых типов лесов в степень водного режима влечет за собой много субъективных суждений. Поэтому автор, адаптируя работу Laatsch (1969) на венгерские буковые леса попытался охарактеризовать степень водного режима некоторых типов лесов объективными измерителями. В статье дается описание и оценка метода, оценка данных материала, взятого с места обитания, обощена в таблице.

ИЗУЧЕНИЕ РОСТА ДВУХ СОРТОВ ПРЯНОЙ ПАПРИКИ

К. ВИРАГ

В данной статье автор занимается анализом роста двух сортов пряной паприки (КМ-622, КV-1). Опыты проводились с одной стороны в идеальных условиях для произрастания паприки, а с другой стороны в наблагоприятных условиях, для того, чтобы сравнить, каким образом влияет на рост и количество урожая сортов различие в сельскохозяйственных площадях. В статье даются следующие показатели роста: RGR, RLGR, NAR, LAR, spec. LA и LWR. Цель анализа роста заключалась в том, чтобы с одной стороны получить информацию об изменении временных показателей роста у сортов, а с другой стороны насколько выражена разница в ростовой и ассимиляционной рате. Автор изучал связь между показателями роста и веса плодов. При помощи анализа-path изучалось влияние внешних факторов на показатели роста и вариабильность количества урожая в различных условиях у двух сортов паприки.

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Index: 26.006
HU ISSN 0001—5350

ACTA BOTANICA

ACADEMIAE SCIENTIARUM HUNGARICAE

VOLUME 27 NOS 3–4

AKADÉMIAI KIADÓ, BUDAPEST

1981

ACTA BOT. HUNG.

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A QUARTERLY OF THE HUNGARIAN ACADEMY OF SCIENCES

Acta Botanica publishes original reports on botanical subjects in English, French, German, Spanish and Russian

Acta Botanica is published in yearly volumes of four issues by

AKADÉMIAI KIADÓ
Publishing House of the Hungarian Academy of Sciences
H-1054 Budapest, Alkotmány u. 21.

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Acta Botanica Academiae Scientiarum Hungaricae, Vol. 27 (3—4), pp. 281—284 (1981)

PROFESSOR IMRE MÁTHÉ 70 YEARS OLD

When academician Imre MÁTHÉ was awarded a high government distinction—Gold Order of Labour—on occasion of his 70th birthday, he said: "*At first I wanted to be a geologist or mining engineer but rather early I resolved to devote myself to botany, to 'scientia amabilis' which has accompanied me throughout my life. I strove to work on the solution of problems which would produce results directly applicable in practice. Such are for example the questions of meadow-pasture management or the ecological conditions of the formation of bioactive ingredients of plants. My career may have been disrupted and changes may occurred, but my botanical work, even when without remuneration, has been continuous.*"

He was born on 21st January 1911 in Debrecen where he completed his schooling and university studies. He matriculated in 1929 at the Reformed High School of Debrecen where Andras HOFFER instilled in him a steadfast interest in nature. In 1933 he was awarded "summa cum laude" for his Ph.D. majoring in botany, chemistry and geology being secondary subjects, at the Faculty of Arts department at the University of Debrecen. Already as an undergraduate he assisted under Professor Rezső Soó in the Botanical Institute of Debrecen University from 1931–38 and in 1938–41 as a salaried demonstrator he became an honorary assistant and honorary lecturer. In 1940 as honorary lecturer he won the "venia legendi" prize in the subject of plant geography.

In 1941 he was appointed the new head of the Institute of Botany and acting director of the Botanic Gardens.

His work at the Economic Academy of Debrecen-Pallag, meant the first step in his orientation towards agricultural botany, agrobotany. Beginning from 1944, this connection with the agricultural college and his appointment as associate professor was a close link with Debrecen. After discontinuation of the agricultural classes in 1949 he went to Budapest and then to Gödöllő, to the Agricultural Science Faculty of the University of Agricultural Sciences. Here he was in charge of ordinary professor of the Institute of Botany from 1950 until 1957. He was also elected Rector of the University (1952 and 1956). In the course of these years (between 1942 and 1965) he helped in the founding of several botanic gardens.

This was an exceptionally active period of his life during which teaching and research were closely interwoven. During his teaching activity of one and a half decades he helped to launch several students of agriculture who are now leading experts of their fields, providing for them an example of reliable, honest and thorough work.

In organizing and directing research in agricultural sciences he played a major role in numerous agricultural and academy committees and councils either as president or as a member. His premeditated, constructive, quietly spoken opinions and suggestions could always be relied on.

In addition, he always found time for his vocational botanic research. His Ph.D. thesis was a perspective initiation: "Up-to-date cenological survey of the Ohat forest on the edge of the Hortobágy" (1933). As co-author with Rezső Soó he published works on the critical flora of the Lowland beyond the Tisza (Tiszántúl) and an excellent analysis of flora elements of the vegetation of Hungary (1940–41). The latter came to be the basic work of cenological studies in Hungary and indispensable for flora analyses. Turning to agrobotany he studied the ecology of the dry technology of rice production, the micro-climate of intermediate cultures and provided an orientation for modern weed research (1947–50). He was a pioneer in methods of investigating the plant production of meadows and pastures (1951–56). In recognition of his work the Hungarian Academy of Sciences, on the proposal of the Section of Agricultural Sciences, elected him Corresponding Member of the Academy in 1954, and the following year he was awarded the Kossuth Prize.

The second phase of Imre MÁTHÉ's career was overwhelmingly devoted to research. From 1958 at the Research Institute for Medicinal Plants of the Ministry of Agriculture and Food Production and with more extensive possibilities in his last post at the Research Institute for Botany of the Hungarian Academy of Sciences at Vácrátót from 1964, he quite uniquely in Hungary studied the environmental-ecological conditions of plants containing biological active agents used in medicine. Thus, for example his *Matricaria*

chamomilla investigations, regarded today as classic (1959–1963), have clarified the ecological conditions of the regional distribution according to proazulene content. As a further major achievement he revealed the ecological factors influencing the amount of vincamine formed, as well as the diurnal variation and annual rhythms of this active agent and qualification of Vinca minor habitats (1963–68). Beginning with the taxonomic revision of *Solanum laciniatum* (1962–65), followed by *Solanum dulcamara* (1969–) and continued by investigations into the steroid content of the *Morella* section (1973), he drew important theoretical and practical conclusions.

He contributed to several collective studies on *Amsonia* species and *Rhazya* alkaloids (1964–). Professor MÁTHÉ is not only an advocate of teamwork but he himself actively participated in the work of several teams. There must be no greater satisfaction than to see the continuation of one's work in the young—and not in the least in one's own sons too.

His work was not merely devoted to autecological research, but he also conducted important research in synecology. Together with Margit KOVÁCS he carried out the phytocenological analysis of the vegetation of the Mátra mountains (1956–64). At the Botanical Research Institute of Vácrátót he was one of the chief advocates of research in the framework of the International Biological Programme. Their site of investigation was the forest steppe ecosystem on alkali soils of Újszentmargita on the edge of the Hortobágy. Together with a team including myself, István PRÉCSÉNYI and others, and by introducing up-to-date methods for biological and ecological analyses, he could reach a synthesis after a decade (1966–74). This research and the scientific organizing work of the Institute constituted the basis of botanical and ecological research in Hungary, which is today carried out within the framework of UNESCO's Man and the Biosphere (MAB) programme.

The international relations of Imre MÁTHÉ became extensive after his earlier study tours and his delegation trips (1951–56). For example he was an active participant of the International Botanical Congress in 1964 in Edinburgh (the XIth) in 1969 in Seattle (the XIIth), and in 1974 in Leningrad, and also attended the IVth International Volatile Oils Congress in the Soviet Union (in 1968 in Tbilisi). He was a member of the Hungarian delegation at a conference for experts to prepare the Hungarian State Committee of UNESCO (Paris 1968) and took part in one of the closing symposia of IBP (Rome 1970).

Imre MÁTHÉ was elected full member of the Hungarian Academy of Sciences in 1970. Recently he has taken active part in the work of the Academy, e.g. ~~as~~ an Advisory Member for Publishing House of the Hungarian Academy of Sciences, Akadémiai Kiadó, (1970) and he has been a member of the Botanical Committee since its formation (1952) also being its President in 1970–76. He was active in the Biological Committee of the Commission for Scientific Qualifications (1952–1980). He became editor in-chief of Magyar-

ország Kultúrflórája (1959–) (Cultivated Plants of Hungary) after the death of Sándor JÁVORKA and Ferenc ERDEI.

Now at 70 years of age he has retired from his post of Scientific Adviser but he still plays an important role in Hungarian botany and he is welcome back at the Botanical Research Institute of Vácrátót. His past and present colleagues, friends and students greet Professor Imre MÁTHÉ heartily on occasion of his 70th birthday.

We wish him to be able to continue this "scientia amabilis" in good health with his well-known passion for work.

B. ZÓLYOMI

Acta Botanica Academiae Scientiarum Hungaricae, Vol. 27 (3–4), pp. 285–293 (1981)

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Acta Botanica Academiae Scientiarum Hungaricae, Vol. 27 (3—4), pp. 295—308 (1981)

XYLOTOMIC EXAMINATION OF SOME VENEZUELAN *CAPPARIS* SPECIES, I

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(Received: November 1, 1980)

Morphological, ecological characteristics, habitat and the main anatomical features of the xylem of four Venezuelan *Capparis* species, namely: *C. coccolobifolia* MART. ex EICHL., *C. hastata* JACQ., *C. indica* DRUCE and *C. linearis* JACQ. are described.

Introduction

On the basis of correspondence Prof. Isidro R. BERMUDEZ sent wood samplings of ten *Capparis* species to K. BABOS for xylotomic examination. The ten species are: *Capparis coccolobifolia, C. hastata, C. indica, C. linearis, C. odoratissima, C. pachaca, C. sessilis, C. stenosepala, C. tenuisiliqua, C. verrucosa.* The xylotomic investigation presented in this paper were carried out by K. BABOS. Prof. I. R. BERMUDEZ and Prof. L. J. CUMANA supplied some general features of the *Capparaceae* family and the morphological and ecological data of the collected *Capparis* species.

The *Capparaceae* family consists of 46 genera and approximately 700 species; three genera are pantropical: *Capparis, Cleome* and *Crataeva.*

Capparis is the richest genus in species, with about 350 (LAWRENCE 1951). The genus *Cleome* has been segregated by HUTCHINSON (1973) forming a separate family *Cleomaceae,* which in conjunction with the *Cruciferae* and *Resedaceae* constitutes the order *Brassicales.*

It is necessary to note that the *Capparaceae* family has been the subject of discussions among phylogeneticists; the majority of them agreeing that the *Capparaceae* and *Cruciferae* are closely related.

In the North-eastern region of Venezuela, especially in the State of Sucre, the *Capparis* genus is represented by 10 species (GUZMÁN 1979). Their anatomical structure has not been studied.

With a view to economy, *Capparis spinosa* is considered important here, because of the exploitation of the floral buds (capers) used as comestibles.

In ecological respect *Capparis* species have an extraordinary resistance to drought; the majority of them has persistent, mostly coriaceous leaves and a beautiful foliage. They grow on oligotrophic soil and constitute arborescent forms. Because of these characteristics the species are highly recommended for reforestation of arid zones and for ornamental purposes in squares, avenues, gardens and public places in Venezuela.

Materials and methods

The blocks made from the wood of diverse *Capparis* species were softened in a BRINZER's autoclave, in the 1 : 1 mixture of water and glycerin, at 1.5–2 atm. After maceration, transversal, tangential and radial sections were prepared. The sections were dyed with the alcoholic solution of Toluidin blue. The maceration of tissues was made with the SCHULZE method (SÁRKÁNY and SZALAI 1964).

Length of fibres and vessel elements, tangential and radial diameters of vessels, width and height of medullary rays and other characteristics were measured. The minima-maxima values of the anatomical features of each *Capparis* species were calculated from 50–100 measurements. Enlarged microphotographs were made of each section.

External morphology and distribution

Capparis coccolobifolia MART. ex EICHL.

Tree or shrub 1–5 m high. Glabrous stem, alternate leaves, abovate-elliptical. Lamina 5–17 cm long, with submarginated, mucronated apex; glabrous, coriaceous, discoloured. Racemose inflorescence, terminal, 2–6 cm long. Hermaphrodite, actionomorphic flowers, 3–5 cm long. Calyx with 4 sepals, dialisepals, superposed, two of them 0.5–1 cm long, the other two 4–8 mm long, glabrous, olivaceous; glandulae are present; corolla with 4 contorted petals, dialipetals, 1.5–2.5 cm long, white. Numerous stamina (50–59), 2–3 cm long, anthers with bitheca, 2–4 mm long, longitudinal dehiscence. Papillose ovary above a gynophore 1–2 cm long, unilocular, bicarpel, pseudo-septum is present, numerous ovules, parietal placentation, sessile stigma. Bacciform elongated, sub-cylindrical fruit capsule, dehiscent, 9–21 cm long, rugous, olivaceous.

Habitat: in dry, petrous, arenaceous oligotropic soil. They are growing isolated alone, on the roadside. They are frequent.

Distribution: State of Sucre. In other States: Nva. Esparta, Dtto. Federal, Lara and Falcón.

Capparis hastata JACQ.

Shrub 1–3 m high. Glabrous stem, alternate, elliptical-obovate leaves. Lamina 2–7 cm long with marginated, sub-marginated, obtuse apex; glabrous, coriaceous, discoloured. Racemose inflorescence, terminal, 2–7 cm long. Hermaphrodite, actinomorphic flowers, 3–4 cm long. Calyx with 4 sepals, dialisepals, superposed, glabrous, two of them 6–8 mm long and the other two 4–6 mm long; corolla with 4 white, glabrous petals, dialipetals, contorted, 1–3 cm long. Numerous stamina (120–130), 3–4 cm long; anthers with bitheca, 2–4 mm long, longitudinal dehiscence. Papillose ovary above a gynophore 3–5 cm long; bicarpel, unilocular, pseudo-septum is present, numerous ovules, parietal placentation, sessile stigma. Bacciform, elongated, sub-cylindrical fruit capsule, dehiscent, 8–18 cm long, smooth yellowish green, purple-reddish sutures are present.

Habitat: in dry, petrous, arenaceous, oligotropic soil. They are isolatedly growing in small groups on the roadsides or on beaches. They are frequent.

Distribution: State of Sucre.

Capparis indica DRUCE.

Shrub 1–3 m high. Lepidopterous stem. Alternate, elliptical-abovate leaves; lamina 3–12 cm long with mucronated apex; glabrous, coriaceous, discoloured. Racemose inflorescence, terminal, 2–8 cm long, squamous cover is present. Hermaphrodite, actionomorphic flowers 4–5 cm long: calyx with 4 sepals, dialisepals, valved, 2–3 mm long; glandulae are present; corolla with 4 petals, dialipetals, contorted, lepidopterous, 0.8–1.5 cm long. 15–21 stamina, 2–3 cm long; anthers with bitheca, 2–3 cm long, longitudinal dehiscence. Ovary above a lepidoptereous gynophore 2–3 cm long, bicarpel, unilocular; pseudo-septum is present; numerous ovules, parietal placentation, sessile stigma. Bacciform, elongated, sub-cylindrical fruit capsule, dehiscent, 9–28 cm long, yellowish brown, rough, lepidopterous.

Habitat: in dry, petrous, arenaceous, oligotropic soil. They are growing in isolation on the roadsides and on the hill-slopes; in shadowy or intensively lightened places. They are not very frequent.

Distribution: State of Sucre. In other States: Carabobo.

Capparis linearis JACQ.

Shrub 1–2 m high. Glabrous stem. Alternate, linear leaves. Lamina 2–15 cm long with mucronated apex; glabrous, coriaceous, discoloured. Racemose inflorescence, terminal, 1–7 cm long. Hermaphrodite, actinomorphic flowers 2–3.5 cm long; calyx with 4 sepals, dialisepals, superposed, glabrous, pale green; two of them 4–5 mm long and the other two 2–3 mm long. Corolla with 4 petals, dialipetals, superposed, glabrous, externally white and internally purple-reddish, 0.9–1 cm long. Numerous stamina (72–80), heterodyne, filaments 0.8–3 cm long; anthers with bitheca, 1.5–2 mm long, longitud.nal dehiscence. Sessile, bicarpelar, unilocular ovary, pseudoseptum is present; numerous ovules, parietal, placentation; sessıle stigma. Bacciform, elongated sub-cylindrical, sub-torulose, dehiscent fruit capsule, 4–5 cm long, mildly rough, olivaceous.

Habitat: in dry, petrous, oligotropic soil. They are growing scattered on the hills and roads:des, intensively lightened. They are not very frequent.

Distribution: State of Sucre. In other States: Nva. Sparta, Carabobo, Zulia, Lara, Anzoategui, Falcón and Dtto. Federal.

Wood anatomy

Capparis coccolobifolia MART. ex. EICHL.

Diffused porous wood. The basic mass of wood is formed by polygonal-shaped fibres with thicker wall and medium lumen. Paratracheal and contact vasicentric longitudinal parenchyma. Medullary rays with 1 or more cells wide (Fig. 1).

Roundish or oval-shaped tracheae; the vessels consisting of two members are tangentially flattened; within the Capparis species size is relatively large; rarely with resin content. 22–33–49 tracheae per sq. μm. Tangential diameter 34.5–73.7–78.2 μm. Radial diameter 25.3–148.8–115.0 μm. Length of the vessel
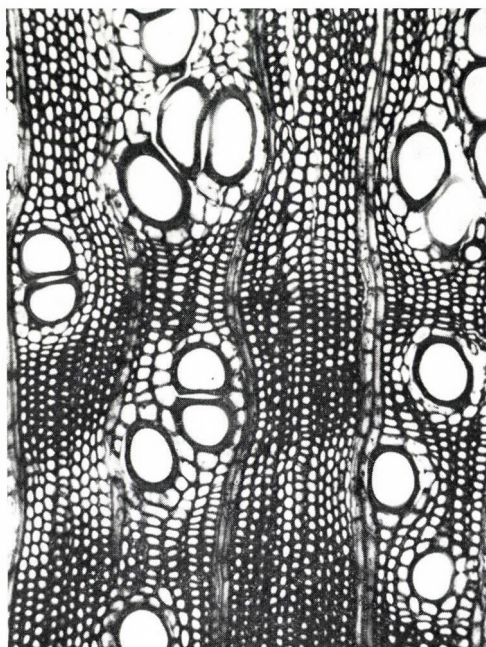
Fig. 1. Capparis coccolobifolia MART. ex. EICHL. Cross-section (120×). Vessels with thick wall, groups of vessels, medullary rays and fibres. Contact vasicentric longitudinal parenchyma
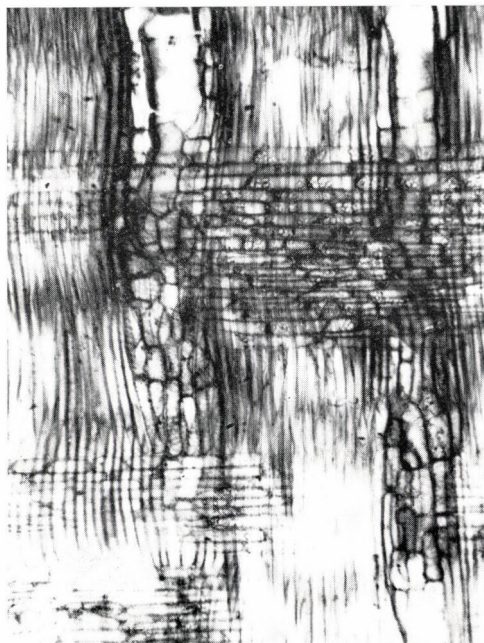
Fig. 2. Capparis coccolobifolia MART. ex. EICHL. Radial section (120×). Heterogeneous and homogeneous medullary rays, vessels, longitudinal parenchyma and fibres. Small crystals in the medullary ray cells

Fig. 3. Capparis coccolobifolia MART. ex. EICHL. Tangential section (120×). Medullary rays 1–2–3 cells wide, fibres with thin wall. Vessel and longitudinal parenchyma
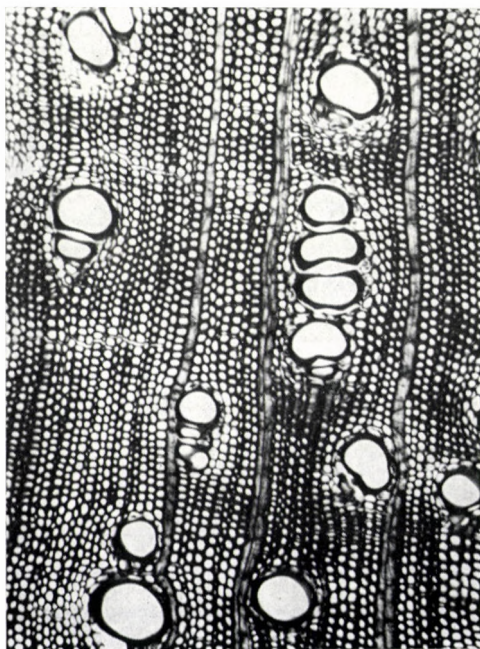
Fig. 4. Capparis hastata JACQ. Cross-section (120×). Vessels, groups of vessels, medullary rays and fibres. Contact vasicentric longitudinal parenchyma
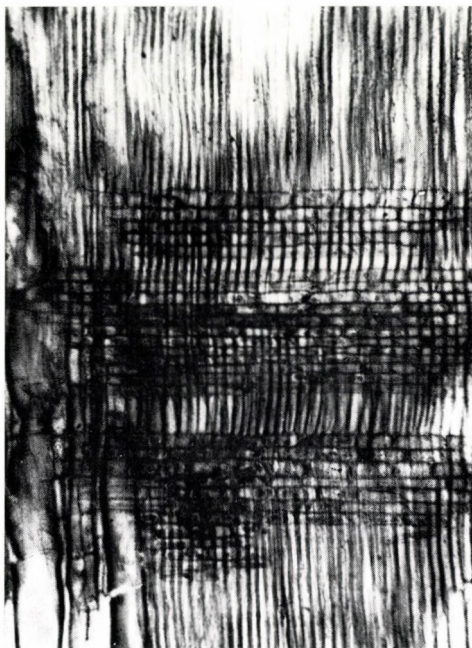
Fig. 5. Capparis hastata JACQ. Radial section (120×). Heterogeneous and homogeneous medullary rays, vessels, longitudinal parenchyma and fibres

Fig. 6. Capparis hastata JACQ. Tangential section (120×). Medullary rays 1–2 cells wide, vessel and longitudinal parenchyma, fibres with thicker wall. Dark mastic material in some longitudinal parenchyma cells

members is 69.0–148.8–230.0 μm; on their wall small bordered pits, in alternated position. Simple perforate plate.

Medullary rays up to 2–3, rarely 1 cells wide; homogeneous or rarely heterogeneous sructure. Height 57.5–208.1–414.0 μm. Width 11.5–19.2–34.5 μm. Small polygonal-shaped crystal frequently present in the ray cells (Figs 2 and 3).

Fibres arranged in radial rows. Diameter 9.3–12.2–15.6 μm. Wall thickness 1.56–2.99–4.68 μm. Full length 213.0–417.4–497.0 μm. Tip of the fibres ending in a point.

Diameter of the longitudinal parenchyma cells up to 6.9–10.2–27.6 μm. Height up to 23.0–69.9–138.0 μm. The cells rarely contain resin or calcium-oxalate crystal.

Capparis hastata Jacq.

Diffused porous wood. The basic mass of wood is formed by fibres with thin wall and medium lumen. Paratracheal contact vasicentric longitudinal parenchyma. Medullary rays up to 1–2 rarely 3 cells wide (Fig. 4).
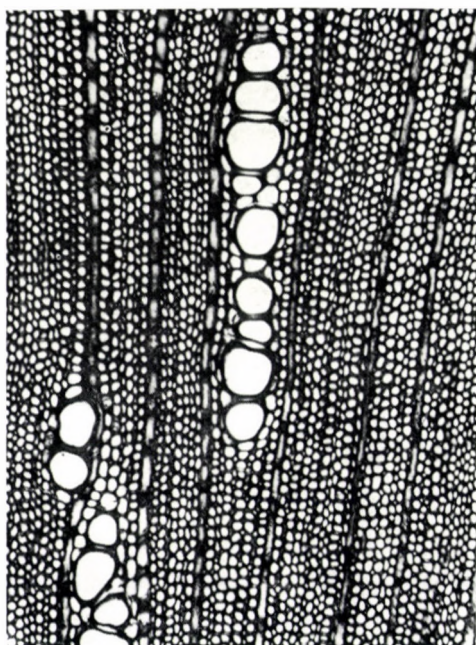
Fig. 7. Capparis indica Druce. Cross-section (120 ×). Groups of vessels in radial direction, among the vessels tracheid-like vessels, medullary rays and fibres. Contact-vasicentric longitudinal parenchyma
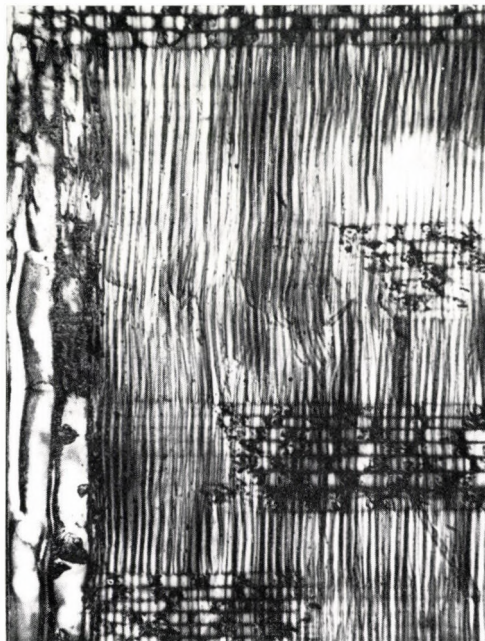
Fig. 8. Capparis indica DRUCE. Radial section (120×). Heterogeneous and homogeneous medullary rays, vessels and fibres, longitudinal parenchyma. Dark mastic material in the vessels, small crystals in the medullary ray cells

Roundish or oval shaped tracheae, tangentially flattened within the groups; relatively large size within the *Capparis* species; rarely with resin content. Their number up to 28–37.5–51 per sq. mm. Tangential diameter 13.8–63.3–138.0 μm. Radial diameter 27.6–60.8–115.0 μm. Length of the vessel members up to 138.0–198.5–322.0 μm; small, oblonged bordered pits on their wall, with alternated position. Simple perforate plate.

Medullary rays up to 1–2, rarely 3 cells wide, with heterogeneous structure, however the rays with homogeneous structure are not rare. Height 57.5–216.6–425.5 μm. Width up to 11.5–19.8–34.5 μm. Ray cells frequently contain resin (Figs 5 and 6).

Fibres are in irregular position. Diameter up to 6.2–12.9–18.4 μm. Wall thickness constantly 1.56 μm. Full length 213.0–390.5–568.0 μm. Tip of the fibres ending in a smooth point.

Diameter of the longitudinal parenchyma cells up to 6.9–12.9–18.4 μm. Height 41.4–58.5–124.2 μm. Cells frequently contain mastic material.

Fig. 9. Capparis indica Druce. Tangential section (120×). Medullary rays 1–2 cells wide, vessel and longitudinal parenchyma, fibres with thin wall
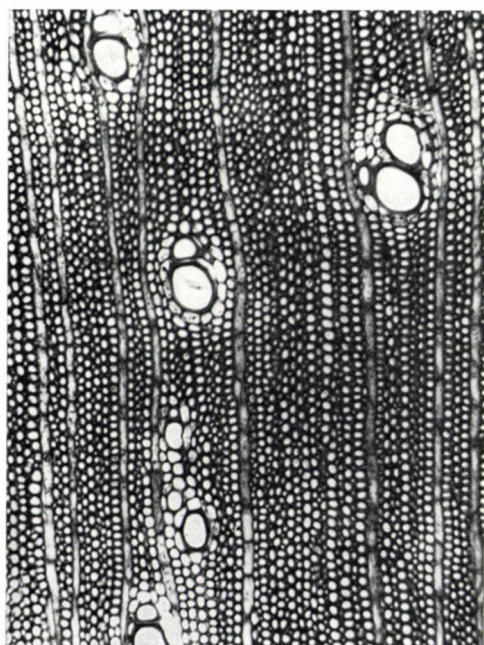
Fig. 10. Capparis linearis Jacq. Cross-section (120×). Vessels, medullary rays and fibres. Beside the vessels tracheid-like vessels in radial direction. Contact vasicentric longitudinal parenchyma

Capparis indica DRUCE.

Diffuse porous wood. The basic mass of wood is formed by polygonal-shaped fibres with thinner wall and large lumen. Paratracheal contact vasicentric longitudinal parenchyma. Medullary rays up to 1 and 2 cells wide (Fig. 7).

Roundish or oval-shaped tracheae, tangentially flattened within the groups. Within the groups of vessels (5–9 members) tracheid-like vessels are present. Vessels with medium size, rarely with mastic-content. Their number up to 18–35.4–58 per sq. mm. Tangential diameter 16.8–59.8–92.0 μm. Vessel members 101.2–181.6–276.0 μm long, on their wall with small oblonged bordered pits, in alternate situation. Simple perforate plate.

Medullary rays up to 1–2 cells wide, with heterogeneous or homogeneous structure. Height 34.5–165.1–333.5 μm. Width 11.5–16.3–28.7 μm. Medullary ray cells contain small, polygonal-shaped crystal (Figs 8 and 9).

Fibres are in irregular or regular rows. Diameter up to 9.3–12.0–17.1 μm. Wall thickness constantly 1.56 μm. Full length up to 284.0–471.4–781.0 μm. Tip of the fibres ending in a smooth point.

Diameter of the longitudinal parenchyma cells up to 9.2–15.1–23.0 μm. Height 36.8–68.4–147.2 μm. The cells frequently contain mastic material.
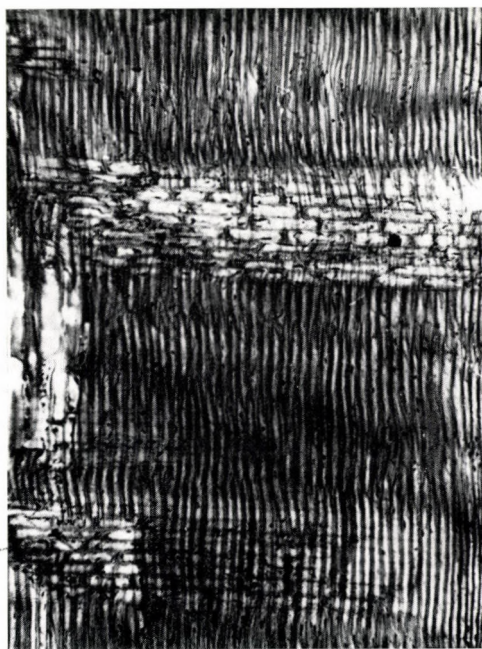
Fig. 11. Capparis linearis JACQ. Radial section (120 ×). Homogeneous medullary rays, vessels, longitudinal parenchyma and fibres

Fig. 12. Capparis linearis JACQ. Tangential section (120×). Medullary rays 1–2 cells wide, vessel, longitudinal parenchyma and fibres. The small bordered pits are weakly visible on the wall of the vessel members

Capparis linearis JACQ.

Diffused porous wood. The basic mass of the wood is formed by polygonal-shaped fibres with thicker wall and medium lumen. Paratracheal contact vasicentric longitudinal parenchyma. Medullary rays generally one and sometimes more cells wide (Fig. 10).

Roundish or oval-shaped tracheae. Within the groups of vessels (2–4 members) tracheid-like vessels are present. Small vessel size. Their number up to 21–28.9–47 per sq. mm. Tangential diameter up to 13.–46.9–66.7 μm. Radial diameter up to 13.8–40.0–64.4 μm. Vessel members up to 64.4–122.8–184.0 μ long, with small bordered pits on their wall, in alternate position. Perforate plate simple.

Medullary rays up to 1–2 cells wide, rarely 3 cells wide, with heterogeneous and frequently homogeneous structure. Height up to 34.5–118.2–241.5 μm. Width 11.5–17.7–28.7 μm (Figs 11 and 12).

Fibres are arranged in radial rows, sometimes in irregular position. Diameter up to 7.8–11.3–14.0 μm. Wall thickness up to 1.56–2.26–3.12 μm. Tip of the fibres ending in a smooth point.

Table 1

Anatomical features of the species examined

Wood elements	Characteristics	*C. coccolobifolia*	*C. hastata*	*C. indica*	*C. linearis*
Trachea members	Arrangement	solitary or radial group of 2–7 members	solitary or radial group of 2–4 members	solitary or radial group with 2–9 members	solitary or radial group with 2–4 members
	Shape	roundish or oval, or flattened in tangential direction	roundish or oval, tangentially flattened in the groups	roundish or oval or tangentially flattened	roundish or oval
	Tangential diameter	34.5–59.9–78.2 μm	13.8–63.3–138.0 μm	34.5–66.0–108.1 μm	13.8–46.9–66.7 μm
	Radial diameter	25.3–73.7–115.0 μm	27.6–60.8–115.0 μm	16.8–59.8–92.0 μm	13.8–40.0–64.4 μm
	Length of vessel members	69.0–148.8–230.0 μm	138.0–198.5–322.0 μm	101.2–181.6–276.0 μm	64.4–122.8–184.0 μm
	Wall thickness	4.6–6.6–11.5 μm	1.5–4.1–6.9 μm	2.3–4.6–6.9 μm	2.3–3.6–6.9 μm
	their number per 1 sq.mm.	22–33–49	28–37.5–51	18–35.4–58	21–28.9–47
	Intervascular pitting	very small, bordered	small, oblonged, bordered	small, oblonged, bordered	small, bordered
	Perforate plate	simple	simple	simple	simple
	Content	rarely mastic material	rarely mastic material	rarely mastic material	—
Medullary rays	Width	narrow	narrow	narrow	narrow
	Number of cells	2–3, rarely 1	1–2, rarely 3	1–2	1–2, rarely 3
	Classification	homogeneous, rarely heterogeneous	heterogeneous, or homogeneous	heterogeneous or homogeneous	heterogeneous or homogeneous
	Height	57.5–208.1–414.0 μm	57.5–216.6–425.5 μm	34.5–165.1–333.5 μm	34.5–118.2–241.5 μm
	Width	11.5–19.2–34.5 μm	11.5–19.8–34.5 μm	11.5–16.3–28.7 μm	11.5–17.7–28.7 μm
	Content	calcium-oxalate crystal	mastic material	calcium-oxalate crystal	—

Fibres	Arrangement	radial rows	irregular	in irregular or radial rows	in radial row, rarely irregular
	Shape	polygonal	polygonal	polygonal	polygonal
	Full diameter	9.3–12.2–15.6 μm	6.2–10.5–14.0 μm	9.3–12.0–17.1 μm	7.8–11.3–14.0 μm
	Wall thickness	1.56–2.99–4.68 μm	1.56 μm	1.56 μm	1.56–2.26–3.12 μm
	Full length	213.0–417.4–497.0 μm	213.0–390.5–568.0 μm	284.0–471.4–781.0 μm	284.0–445.1–710.0 μm
	Type of pit	small, with aperture	small, with aperture	small, with aperture	small, with aperture
Longitudinal parenchyma	Arrangement	contact-vasicentric	contact-vasicentric	contact-vasicentric	contact-vasicentric
	Diameter	6.9–10.2–27.6 μm	6.9–12.9–18.4 μm	9.2–15.1–23.0 μm	9.2–13.8–18.4 μm
	Height	23.0–69.9–138.0 μm	41.4–58.5–124.2 μm	36.8–69.4–147.2 μm	27.6–67.8–119.6 μm
	Number of cells	1–5	1	1–2	1
	Content	rarely mastic material	mastic material	mastic material	mastic material
	Other	very rarely calcium-oxalate crystal	—	—	rarely calcium-oxalate crystal

Diameter of the longitudinal parenchyma cells up to 9.2–13.8–18.4 μm. Height 27.6–67.8–119.6 μm. Cells frequently contain mastic material and rarely calcium-oxalate crystal, too.

The detailed anatomical features of the wood of the *Capparis* species are shown in Table 1.

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Acta Botanica Academiae Scientiarum Hungaricae, Vol. 27 (3–4), pp. 309–312 (1981)

STUDIES IN RONDELETIEAE (RUBIACEAE) I. A NEW GENUS: ROIGELLA

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A new Cuban monotypic genus is separated from *Rondeletia* L. under the name *Roigella* based on the species *Rondeletia correifolia* GRISEB. Upon a comparative morphological study of the Antillean species of the genus *Rondeletia*, its chief generic characteristics are also discussed. The new genus is dedicated to the memory of the great Cuban botanist and pharmaceutist, Juan Tomás ROIG MESA.

The genus *Rondeletia* had been described by LINNÉ in Species Plantarum (1753: 172) based on *Rondeletia americana* L. a species of rather limited distribution in the West Indies, living in Jamaica and St. Vincent. Later the generic concept of *Rondeletia* has been widened considerably by A. DE CANDOLLE, HEMSLEY, STANDLEY and URBAN. A recent comparative morphological revision of the West Indian species of *Rondeletia* convinced us, that its generic characteristics are as follows:

Rondeletia L.: *Hypanthium globose, calyx 4–5-lobate, lobes various in form and size, persistent. Corolla usually funnelform, 4–5-lobate, tube essentially glabrous within, the throat naked covered by annular lamellas, squamules or denticles; lobes imbricate. Stamens 4 or 5, inserted in throat or in the tube of the corolla, filaments short, naked, anthers subsessile, dorsifixed, oblong-elliptic. Disk annular hirsute or villous. Style 2-lobate, usually pubescent, at least near the base. Pollen grains 3-colporate, prolate, exine minutely foveolate. Placenta hemisphaeric, coriaceous, with a central insertion to the septum, horizontally or vertically sulcate, ovules numerous. Capsule globose, cartaceous or coriaceous, 2-celled, 2-valvate, loculicidally dehiscent. Seeds angulate or fusiform, sometimes appendiculate, rarely winged.*

The plants of the mentioned characteristics are shrubs or trees with terete or angulate, glabrous or pubescent branches; with leaves opposite or sometimes verticillate, membranaceous or coriaceous, stipules interpetiolar various, usually persistent. Inflorescence usually axillary, sometimes terminal and axillary, cymose, corymbose, capitulate or 1-flowered.

The combination of the above characteristics is repeated so constantly by about hundred West Indian species, that we do not see any reason to include other species or species-groups having a different combination of morphological features into *Rondeletia*.

Roigella was treated by STANDLEY (1918: 85) as a monotypic section under the name of *Correifoliae* of the genus *Rondeletia*, characterized by large, coriaceous, sparsely sericeous leaves, erect small stipules, axillary cymose, few-flowered inflorescences, 5–6-parted flowers, large calyx lobes, very large corolla retrorse pilose outside, naked in the throat, by very large pyriform capsule and seeds appendaged at each end. A reexamination of this monotypic taxon led to recognizing further important anatomic features in ovary, placentation and pollen grain pattern, which support the segregation of *Rondeletia correifolia* at generic level.

The new genus *Roigella* differs from *Rondeletia* in having oblong-obovate ovary with a widened and costate calyx tube above, 4–5-colporoidate, subsphaeroidal and widely foveolate pollen grains (Fig. 1), a different type of placentation and oblong, septicidally dehiscent capsule. The placenta is shieldform with a longitudinal linear insertion to the septum. Ovules numerous, crowded and imbricate laterally in a horizontal disposition. Seeds compressed, appendaged at each end.

Its closest relative seems to be the monotypic *Acunaeanthus* (BORHIDI, J. KOMLÓDI and MONCADA 1981) of West-Cuba, with its similarly oblong, septicide capsule and 2-alate seeds. But the latter genus differs from *Roigella* in having terminal inflorescence, 4-parted flowers, bearded corolla throat, a glabrous 4-parted disk, 3-colporoidate pollen grains, central insertion of placenta and vertically disposed seeds.

Roigella BORHIDI et M. FERNANDEZ **genus novum** Rubiacearum (Syn.: *Rondeletia* L. sect. *Correifoliae* STANDLEY N. Amer. Fl. 32: 85. 1918)

Frutices vel arbores parvae usque ad 2–3 m altae. Rami teretes vel subangulati, hirtuli. Stipulae erectae, rigidae, deltoideo-cuspidatae, 5–7 mm longae, sericeae. Folia opposita, ovata vel, oblongo-ovata, basi subcordata, subsessilia, margine plana, coriacea. Inflorescentiae axillares, cymosae, pauciflorae, pedunculis longis, erectis, floribus subsessilibus, 5–6-meris. Calycis tubus obovatus, superne ampliatus, sub lobis costis 10–12 turbinatus. Corolla alba, extus dense retrorso-hirtula, intus glabra, lamellis faucialibus obsita, lobi 5–6, semiorbiculares. Stamina 5–6, in tubo corollae sub fauce inserta, filamenta brevia, antherae oblongo-ellipticae, subsessiles, dorsifixae. Stylus bilobatus, basi hirtulus. Granum pollinicum 4–5-colporoidatum, late globosum, exine crassum, foveolato-reticulatum. Discus ovarii annularis, dense villosus. Capsula oblongo-pyriformis, hirsutus, 2-locularis, septicide 4-valva. Placenta coriacea, scalptiformis, oblongata, in septum ovarii insertione lineari per totam longitudinem adhaerens. Ovula numerosa, in sulcis horizontalibus densissime disposita, imbricata. Semina oblongo-lanceolata 2-appendiculata vel acute bialata.

Species typica: *Rondeletia correifolia* GRISEB.

Roigella correifolia (GRISEB.) BORHIDI et FERNANDEZ **comb. nova.** — *Rondeletia correifolia* GRISEB. Cat. Plant. Cub. 1866: 129. Typus: Wright 2684. W-Cuba, Isle of Pine.

The authors wish to dedicate this new genus to the memory of the great Cuban botanist and pharmaceutical chemist, Juan Tomás ROIG MESA at the occasion of his 105th anniversary.
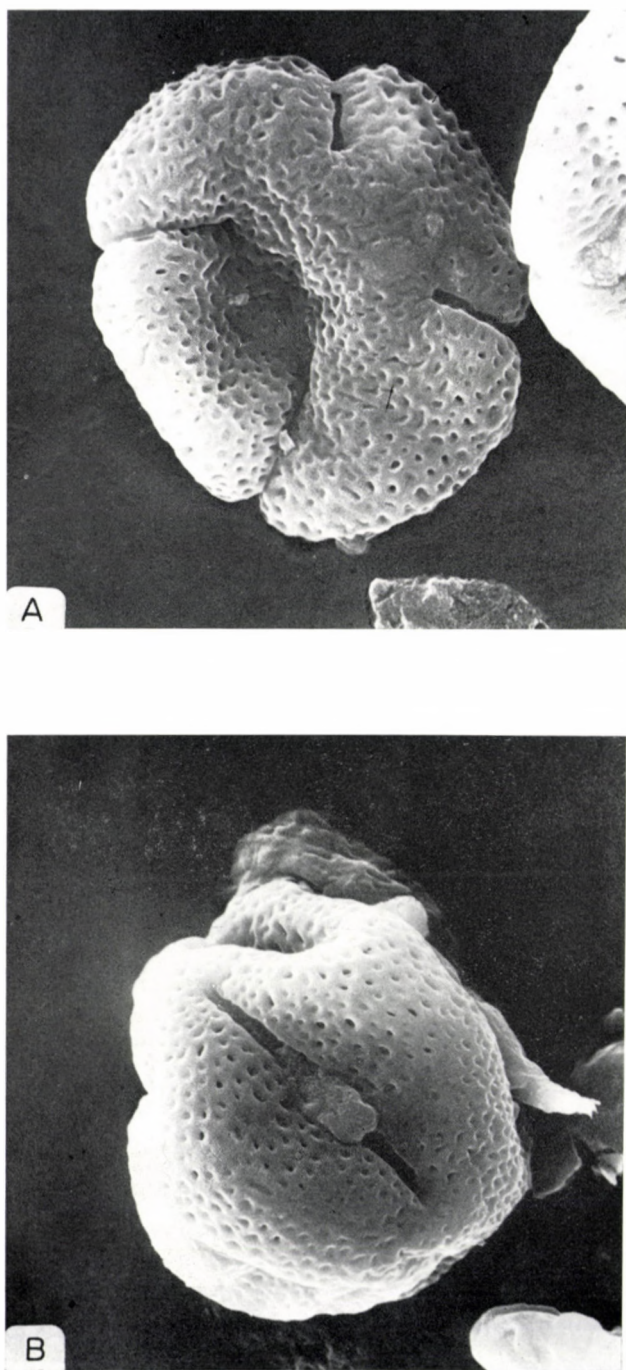
Fig. 1. Pollen of *Roigella correifolia* (GRISEB.) BORHIDI et FERNANDEZ (WRIGHT 2684), ×2000. A: apical view; B: lateral view. Photo: Dr. K. VÁNKY

ACKNOWLEDGEMENTS

This study was supported by the bilateral scientific agreement between the Hungarian and Cuban Academies of Sciences respectively and partly by the treatment firmed by the Royal Swedish Academy of Sciences and the Hungarian Academy of Sciences.

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Acta Botanica Academiae Scientiarum Hungaricae, Vol. 27 (3—4), pp. 313—316 (1981)

STUDIES IN RONDELETIEAE (RUBIACEAE) II. A NEW GENUS: SUBERANTHUS

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A new genus with a distribution in Cuba and Hispaniola is separated from *Rondeletia* L. under the name *Suberanthus*, based on the species *Exostema neriifolium* A. RICH. The genus differs from *Rondeletia* L. in several basic features, and belongs probably to *Cinchoneae* and not to *Rondeletieae*. Five species are belonging to the new genus.

The new genus is rather far from *Rondeletia* and has a number of characters, which are more common in the tribes *Cinchoneae* and *Condamineae* than in *Rondeletieae*. The roughly reticulate exine-pattern of the pollen grains with deep lacunes (pollen type no. III. of AIELLO) is characteristic for many genera of *Condamineae*, e.g. *Pinckneya* and *Rustia*. The ascending placenta and the winged seeds refer to a very close relation to *Cinchoneae*. The form and dehiscence of the capsule resembles very much to that of *Exostema*. The coriaceous blackish-purple corolla, the naked annular disk and the short calyx lobes resemble to those of *Ferdinandusa*. Based on these characters we prefer to classify this new genus into *Cinchoneae*.

The combination of the mentioned features seems to be constant and repeats consequently in every species of the genus *Suberanthus*. It is a remarkable fact, that most of the species belonging to *Suberanthus* were described in other genera and not in *Rondeletia*. The first species had been described by A. RICHARD (1850: 7) as a new *Exostema* (*E. neriifolium* A. RICH.) and further two species were described by GRISEBACH (1862: 505) as new members of the genus *Ferdinandusa* POHL (*Ferdinandea* in GRISEBACH): *F. stellata* and *F. brachycarpa*. Later all the three species were included in *Rondeletia* by CH. WRIGHT (in SAUVALLE: Flora Cubana), but K. SCHUMANN (in Natürlichen Pflanzenfamilien IV./4: 51, 1897) reclassified the mentioned species as members of the section *Gomphosia* of *Ferdinandusa*, together with *F. elliptica* POHL. URBAN reflexed immediately (1898: 263) to this concept considering these species belonging better to *Rondeletia* than to *Ferdinandusa*. STANDLEY (N. Amer. Fl. 32: 62, 1918) created a new section: *Stellatae* within *Rondeletia* for the questioned species-group, but this section proved to be heterogenous by including *Rondeletia subglabra* KR. et URB., which does not belong to this taxonomic unit, being a really good *Rondeletia*.

The genus *Suberanthus* differs from *Rondeletia* L. (see the generic characters in BORHIDI and FERNANDEZ: 1981: 309.) in having oblong-pyriform ovary, with lignified walls, naked disk annular, suberously lepidote, frequently lenticelled exocarpium; coriaceous corolla with thickened angustate throat, but without faucial squamules, lamelles or denticles; 3-colporate, roughly reticulate pollen grains with deeply lacunate reticulum and rugulate surface (Figs 1–2); ovary with basal or subbasal placentation and with an ascendent placenta; oblong-pyriform, septicidally dehiscent 4-valvate capsule and winged seeds with laciniate margine.

URBAN (1898: 263) discussing the taxonomic position of the Cuban *Ferdinandusa*-species stated that the fruits open first loculicidally. We observed hundreds of capsules opening septicidally from the first moment and in any case has been experienced a loculicidal dehiscence. The structure of placentation was not studied by URBAN.

The genus *Ferdinandusa* POHL (*Ferdinandea* POHL) (tribe *Cinchoneae*) differs from *Suberanthus* in having angulate-costate ovary, large, slightly zygomorphic corolla with amplified, not thickened throat, stamens radicated in the middle of the corolla tube, unequal, long filaments, transversally placed anthers long exerted from the throat of the corolla. Placenta oblong-linear with a longitudinal insertion in the whole length of the septum. Ovules few, pendulous, imbricate. Capsule oblong-elliptic or oblong-linear, large, costate.

The generic characteristics of *Suberanthus* are as follows:

Suberanthus BORHIDI et FERNANDEZ **genus novum** Rubiacearum (tribe: *Cinchoneae*)

(Syn.: *Ferdinandea* sensu GRISEB. nom. nud. 1862. Mem. Amer. Acad. Sci. et Art. **8:** 505. non *Ferdinandea* POHL nec *Ferdinandusa* POHL; *Rondeletia* L. sectio *Stellatae* STANDLEY p. maj. p. N. Amer. Flora **32:** 62. 1918.)

Frutices vel arbores parvae cubanae atque hispaniolanae, usque ad 5–8 m altae. Rami plerumque teretes, glabri, rariter sericei. Stipulae parvae, triangulares, coriaceae. Folia opposita vel ternata, rariter verticillata, coriacea, plerumque glabra, obovata vel oblonga. Inflorescentiae terminales, cymosae, cymae plerumque 9-florae in inflorescentiam thyrsoideam multifloram compositae. Flores atrorubentes, glabri vel sericei, 4-meri. Hypanthium obovato-pyriforme, calycis lobi 4, aequales vel inaequales, hypanthio breviores; corolla parva, radialis, coriacea, 4-mera, tubus intus glaberrimus, fauce anillo valde incrassato angustata, glabra, lamellae vel denticuli fauciales absentes, extus glabra vel rariter sericea, lobi 4, orbiculari-obovati, rotundati vel truncati, in aestivatione imbricati. Stamina 4, supra medium tubi corollae inserta, filamentis brevissimis affixa, antherae oblongo-ellipticae, sub fauce corollae insertae, dorsifixae. Stylus breviter bilobatus, glaberrimus, discus annularis vertice ovarii elevatus, glaber. Grana pollinica 3-colporata, elliptico-subsphaeroidea, exine remote reticulatum, non foveolatum, areolae reticuli amplae, profundae superficie rugulosae (Figs 1–2.). Ovarium obovatum vel pyriforme, 2-loculatum, placentae obovatae, in septum loculi basi insertae, adscendentes, coriaceae vel oseae, verticaliter sulcatae; ovula numerosa, verticaliter disposita, imbricata. Capsula pyriformis, lignosa, lepidota et saepe lenticellis suberosis obtecta, septicide dehiscens, 4-valva. Semina discoidea, circumcirca alata, irregulariter laciniata vel fimbriata.

Species typica: *Exostema neriifolium* A. RICH.

Suberanthus brachycarpus (GRISEB.) BORHIDI et FERNANDEZ **comb. nova.** — *Ferdinandea brachycarpa* GRISEB. Mem. Amer. Acad. Sci. et Art. **8:** 505. 1862. — *Rondeletia brachycarpa* WR. in SAUV. Anal. Acad. Habana **6:** 122. 1869. — *Rondeletia camagüeyensis*
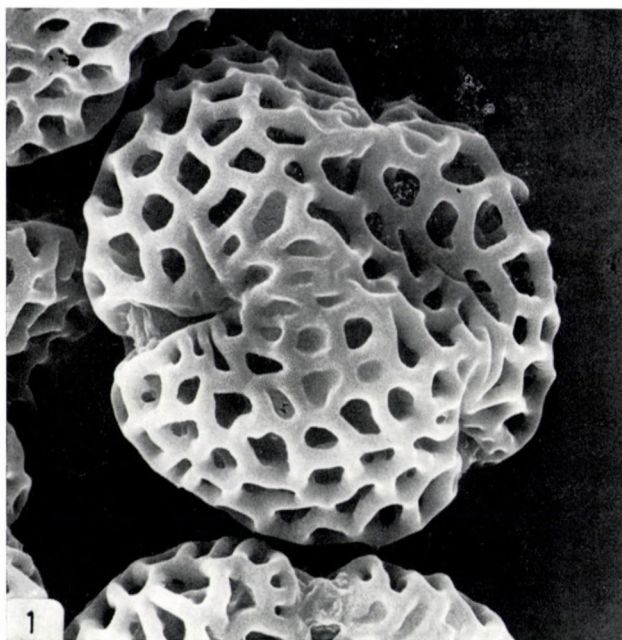
Fig. 1. Pollen grain of *Suberanthus neriifolius* (A. RICH.) BORHIDI et FERNANDEZ (×2000) apical view. Photo: Dr. K. VÁNKY
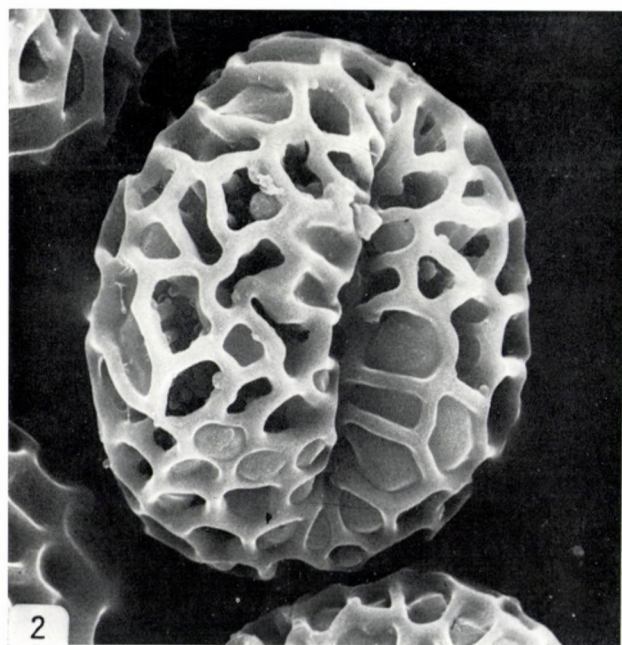
Fig. 2. Pollen grain of *Suberanthus brachycarpus* (GRISEB.) BORHIDI et FERNANDEZ (×2000) lateral view. Photo: Dr. K. VÁNKY

BRITT. Bull. Torr. Bot. Club **44:** 30. 1917. — *Rondeletia ternifolia* URB. Symb. Ant. **9:** 516. 1928. — Cuba, Hispaniola.

Suberanthus canellifolius (BRITT.) BORHIDI et FERNANDEZ **comb. nova.** — *Rondeletia canellifolia* BRITT. Bull. Torr. Bot. Club **44:** 24. 1917. — *Rondeletia stellata* ssp. *canellifolia* BORHIDI Bot. Közlem. **62:** 27. 1975. — Cuba.

Suberanthus neriifolius (A. RICH.) BORHIDI et FERNANDEZ **comb. nova.** — *Exostema neriifolium* A. RICH. in SAGRA Hist. Fis. Pol. Nat. Cuba XI: 7. 1850. — *Ferdinandea angustata* WR. in GRISEB. Cat. Plant. Cub. 1866: 127. — *Rondeletia angustata* WR. in SAUV. Anal. Acad. Habana **6:** 122. 1869. — *Rondeletia calcicola* BRITT. Bull. Torr. Bot. Club **43:** 467. 1916. — *Rondeletia neriifolia* URB. Symb. Ant. **9:** 514. 1928. — Cuba.

Suberanthus stellatus (GRISEB.) BORHIDI et FERNANDEZ **comb. nova.** — *Ferdinandea stellata* GRISEB. Mem. Amer. Acad. Sci. et Art. **8:** 505. 1862. — *Rondeletia stellata* WR. in SAUV. Anal. Acad. Habana **6:** 122. 1869. — Cuba.

Suberanthus yumuriensis (BRITT.) BORHIDI et FERNANDEZ **comb. nova.** — *Rondeletia yumuriensis* BRITT. Bull. Torr. Bot. Club **44:** 25. 1917. — *Rondeletia stellata* ssp. *yumuriensis* BORHIDI Bot. Közlem. **62:** 27. 1975. — Cuba.

ACKNOWLEDGEMENTS

This study was supported by the bilateral scientific agreement between the Hungarian and Cuban Academies of Sciences respectively as a contribution to the New Flora of Cuba programme, and it was helped also by the Institute of Systematic Botany of the University of Uppsala — director Prof. O. HEDBERG —, and by the Phanerogamic Botanical Section of the Riksmuseum of Stockholm — director Prof. A. NORDENSTAM, curator Dr. B. SPARRE —, in the framework of the scientific treatment firmed by the Royal Swedish Academy of Sciences and the Hungarian Academy of Sciences. The authors are also indebted to Dr. K. VÁNKY, mycologist in the Uppsala University, for the Scanning-Electronmicroscopic studies of the pollen grains.

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Acta Botanica Academiae Scientiarum Hungaricae, Vol. 27 (3–4), pp. 317–318 (1981)

A NEW FIDDLE-WOOD FROM CUBA

CITHAREXYLUM MATHEANUM SP. N.

By

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(Received: January 5, 1981)

A new fiddle-wood species from the family *Verbenaceae*, detected by A. BORHIDI in the Escambray Massiv of Central Cuba is described. The species is dedicated to the honour of the outstanding Hungarian botanist, academician prof. Imre MÁTHÉ by the name of *Citharexylum matheanum* sp. n. in occasion of his 70th birthday.

Citharexylum matheanum Borhidi et Kereszty sp. n.

Frutex vel arbor parva, usque ad 3–4 m alta. Ramuli quadranguli, breviter pilosi et ferrugineo-pulverulentes, floriferi abbreviati. Petiolus 4–10 mm longus, pilosus, apice non glandulosus. Folia opposita, elliptica vel obovata, antice rotundata, apice ipso obtuso vel truncato, plerumque emarginato, basi longe cuneata et in petiolum protracta, 15–60 mm longa et 10–25 mm lata, nervo primario utrinque crasse prominenti, lateralibus utrinque 3–5 arcuato-adscendentibus utrinque manifestis et tenuiter prominulis, secundariis parum conspicuis, laxe reticulatis, lamina coriacea vel subcoriacea, supra nitida, viridis, in sicco brunnea, subtus pallida et opaca, adpresse pulverulento-tomentosa, sub tomento densissime glanduloso-punctulata, postremo glabrescens, supra glabra et squamis sessilibus albis satis dense dispositis, postremo caducis suffulta, subtus ad nervos puberula, margine plana vel tenuiter recurva.

Racemi terminales, simplices, breves, usque ad 2–3 cm longi, 5–15-flori; pedunculus 5–10 mm longus, puberulus rhachis breviter pilosa, pedicelli fructiferi 0.5–1 mm longi, crassi erecti, puberuli. Bracteae 0.5–0.7 mm longae, incrassatae, apice acutae. Flores non visi. Infrutescentia erecta, fructus patentes. Calyx fructifer 5-merus, 5-nervus, cyathiformis, 2–3 mm longus, extus glaber, margine truncatus, edentatus, intus adpresse pilosus. Drupa depresse globosa vel obovata, apice truncata lucide rubra, 4–5 × 4–6 mm in diametro. Pyrenae uniloculares. Embryo ellipticus, 2.5–3.5 mm longus, 1.5 mm latus, 1 mm crassus, radicula 0.7 mm longa.

Holotypus: BORHIDI 15049; Cuba centralis, Prov. Sancti Spiritus (Las Villas p.p.) Sierra de Escambray, Pico Chico del paredón grande del Pico Potrerillo, 750–850 m.s.m., Topes de Collantes. 3. Oct. 1978. Leg.: A. BORHIDI et T. PÓCS. Holotypus: HAC; isotypi: BP, VBI.

Obs.: *Citharexylo albicauli* TURCZ. (typus: P!) affinis quae a specie nostra ramulis albidis, glabris, petiolis apice glandulosis, foliis oblongis, subtus dense reticulato-nervosis, infrutescentia elongata, laxa et glabra, calyce manifeste

Fig. 1. Isotype specimen of *Citharexylum matheanum* BORHIDI et KERESZTY sp. n. (BORHIDI 15049 in BP)

4–5-dentato, dentibus 1 mm longis, pyrenis 2-locularibus differt. A *Citharexylo caudato* L. species nostra foliis multo minoribus, basi eglandulosis, subtus pulverulento-tomentosis, inflorescentiis densis brevibusque erectis, pedunculis pedicellibusque multo brevioribus, floribus erectis, fructibus minoribus differt.

Hanc speciem academico et professori botanicae hungarico Dr-i Imre MÁTHÉ, in scientiis phytogeographiae, geobotanicae atque oecologiae plantarum excellenti, ex occasione anniversarii septuagesimi nativitatis dedicavimus.

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Acta Botanica Academiae Scientiarum Hungaricae, Vol. 27 (3—4), pp. 319—323 (1981)

EFFECT OF THE ENVIRONMENT OF THE MOTHER PLANTS OF *CASSIA SOPHERA* VAR. *PURPUREA* ON THE GERMINATION OF THEIR SEEDS

By

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(Received: June 10, 1981)

Of the various factors under which the mother plants of *Cassia sophera* var. *purpurea* are raised, three seem to be most significant in controlling the germination response of the harvested seeds. These include the seed type, time of sowing and watering regime.

Introduction

That parental environmental conditions during embryogeny can bring about qualitative changes in the future germinability of the seed has been investigated (KOLLER 1962, DATTA et al. 1972, JUNTILLA 1973). In these work, day length and temperature have been cited as the environmental variables to which the germinating mother plants have been exposed.

It is not known whether the application of nutrients and growth regulators as well as the imposition of watering regime to the growing plants can alter subsequent germination responses of harvested seeds. In this study, mother plants of *Cassia sophera* var. *purpurea* L. were subjected to these treatments as soon as the plants were established and harvested seeds were put to germination tests after acid-scarification.

Material and methods

Fully mature and dry fruits of *C. sophera* var. *purpurea* were collected from a roadside in Kalyani, Nadia, West Bengal in December, 1977. On separating the seeds from the fruits, two types were found: normal (large and flat) and deformed (smaller and varying in shape). Seeds of each type were scarified with conc. H_2SO_4 for 20 min, washed thoroughly in water and sown in pots containing garden soil mixed with cowdung manure. These plants were watered as and when necessary. In course of time, these plants produced flowers and fruits. Mature fruits were harvested from plants arising from normal as well as deformed seeds. Seeds from these fruits were tested for their germinability.

Subsequently, normal seeds only were used for further experiments. After acid-scarification and thorough washing, seeds were sown at different seasons, such as pre-monsoon, monsoon, winter and post-monsoon. In time these plants yielded sufficient number of fruits, the seeds of which were put to germination tests.

In the third experiment, acid-scarified normal seeds were sown in pots. When the plants were one-month old, potassium nitrate solution (0.125–1.0 per cent) was applied to the soil at weekly intervals and the treatment was continued for 6 weeks. Each pot received

200 ml of the nutrient each time. Seeds produced by such treatments were collected and set for germination.

In the fourth experiment, plants arising from acid-scarified normal seeds, were kept under the following water regimes: daily, alternate days and watered after 2, 4, 6 and 15 days' intervals. Seed from these plants were examined as to their germination.

In the fifth experiment, those plants which originated from acid-scarified normal seeds were sprayed with three growth regulators like GA_3 (Gibberellic acid), Ethrel (2-chloro-ethyl phosphonic acid) and 2,4,5-T (2,4,5-trichlorophenoxy acetic acid). Although these plants were sprayed to the dripping point, GA_3 was sprayed twice and the other growth regulators were used once. The seeds produced by these plants were collected and subjected to germination study.

Seeds from various conditions of the mother plants were acid-scarified and placed in 9-cm Petri dishes on moist filter paper. There were four replicates per treatment. In each dish, 25 seeds were scattered and 4 ml of water was added. Then the dishes were held at room temperature (23 ± 2 °C) and germination counts taken after 7 days.

Results

Normal seeds of *C. sophera* var. *purpurea* germinated better than deformed seeds (Table 1).

Seeds, raised from plants sown at various seasons, yielded variable germination percentages (Table 2). Germination was maximum in seeds from pre-monsoon plants and minimum in seeds from monsoon plants. Of the two other seasons, germination from seeds of post-monsoon plants was higher than that from winter plants.

Table 1

Relation between seed type of mother plants and Cassia seed-germination

Seed-type of mother plants	Percentage of germination
Normal	97.0 ± 2.8
Deformed	57.5 ± 9.4

Table 2

Relation between sowing season of mother plants and Cassia seed-germination

Sowing season of mother plants	Percentage of germination
Pre-monsoon	87.5 ± 7.5
Post-monsoon	77.5 ± 7.5
Winter	65.0 ± 15.5
Monsoon	55.0 ± 8.6

Compared to the seed germination of control plants which received no KNO_3, seeds from plants treated with the compound gave reduced germination (Table 3). While the germination of seeds from plants treated with 0.125% solution was low, it was higher in rest of the pre-treatments.

Table 3

Relation between KNO_3 application to mother plants and Cassia seed-germination

Soil application of KNO_3 (per cent) to mother plants	Percentage of germination
1.0	82.5 ± 4.2
0.5	90.0 ± 4.5
0.25	85.0 ± 8.6
0.125	67.5 ± 8.5
Control	95.0 ± 2.8

Table 4

Relation between watering of mother plants and Cassia seed-germination

Watering of mother plants	Percentage of germination
Daily	95.0 ± 2.8
Alternate days	75.0 ± 8.6
After 2 days	70.0 ± 4.0
After 4 days	82.5 ± 8.5
After 6 days	47.5 ± 9.4
After 15 days	17.5 ± 7.5

In comparison with the germination of seeds from plants which were watered daily, seeds from plants which were watered at various intervals produced lower germination (Table 4). Seed germination from plants watered after 6 and 15 days' intervals was very low and that from plants watered after shorter duration was quite high. In fact, seeds from plants watered after 15 days' interval gave poorest germination.

Seed germination from control plants as well as plants sprayed with GA_3, Ethrel and 2,4,5-T were more or less the same (Table 5).

Table 5

Relation between growth-regulator spray to mother plants and Cassia seed-germination

Spraying of mother plants with growth regulators (ppm)		Percentage of germination
GA	1000	97.5 ± 2.5
	100	87.5 ± 7.5
	10	100.0 ± 0
	1	80.0 ± 8.1
Ethrel	1000	0
	100	100.0 ± 0
	10	99.0 ± 1.0
	1	80.0 ± 9.1
2,4,5-T	500	0
	100	100.0 ± 0
	10	100.0 ± 0
	1	100.0 ± 0
	Control	95.0 ± 2.8

Discussion

The present investigation shows that neither the application of KNO_3 nor growth regulators such as GA_3, Ethrel and 2,4,5-T to the mother plants has any promotive effects on subsequent germinability of the harvested seeds of *C. sophera* var. *purpurea.* While the responses of control and treated seeds following the spray of growth regulators are identical, seeds from mother plants treated with KNO_3 yield low germination.

However, three factors seem to induce changes in the germinability of *Cassia* seeds. Firstly, normal seeds can germinate better than deformed seeds due to the supply of more abundant food material in the former. Secondly, germination is best in seeds from pre-monsoon plants and worst in seeds from monsoon plants. Here copious rains and high humidity during the monsoon as well as scanty rains and low humidity during the pre-monsoon influence the germination characteristics of the harvested seeds. Thirdly, the water regime of the growing mother plants can alter subsequent germination behaviour. In this case, germination is reduced if the mother plants are watered at various intervals in comparison with normal (daily) watering. It is apparent that not only unregulated watering (during pre-monsoon and monsoon seasons)

can change the germinability of the harvested seeds but also regulated watering (2, 4, 6 days, etc. interval) can do likewise. Thus, too much water or too less water to the mother plants can also determine the germination traits of the subsequently produced seeds.

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Acta Botanica Academiae Scientiarum Hungaricae, Vol. 27 (3—4), pp. 325—333 (1981)

THE GROWTH DYNAMICS OF CALLUS TISSUES OF ROOT AND LEAF ORIGIN IN *DATURA INNOXIA* MILL.

By

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(Received: November 1, 1980)

Datura innoxia tissue cultures react sensitively to the changes of 2,4-D and kinetine ratio in the culture medium. From the viewpoint of the measured biomass the use of 1 mg/l kinetine and 1 mg/l 2,4-D was found to be optimal. In applying lower or higher auxine and kinetine concentrations, the tissues grew less intensively.

The growth dynamics of callus tissues prepared from the root and the leaf of *Datura innoxia* MILL. on Murashige-Skoog basic culture medium (1 mg/l kinetine and 1 mg/l 2,4-D), cultivated in dark, were studied. During the incubation period (8 weeks) the fresh and the dry weight of the callus tissues as well as their growth rate were measured.

It was found that both callus tissues grew regularly during the eight weeks. In the 6–8th weeks of growth, the increase decelerated, then it stopped completely. Root callus tissues in light grow less than those in dark. At the same time, the leaf callus tissues grow more intensively in light.

Observations were made on the anatomical characteristics of the differentiation of calluses too.

Introduction

The cells of all plant tissue cultures are totipotent, that is, they possess all the informations necessary for the functioning and copying of the whole plant including its secondary metabolism. Considering the theoretical and practical perspectives, tissue cultures are being used to a much greater extent to study secondary metabolites forming in plants (MARÓTI 1976).

Alkaloids have assumed prominence among secondary metabolites. More than 30 alkaloids have been found so far in *Datura* genus (VERZÁR-PETRI 1971). A few decades ago primarily *D. stramonium* was in the centre of focus among the *Datura* species — being a species of the *Datura* genus supplying hyoscyamine. In the last 10–15 years the genus has come to the forefront rather primarily as a possible scopolamine source of the pharmaceutical industry. So interest has increasingly shifted towards *Datura innoxia*.

The tissue cultures and callus tissue growth of *Datura innoxia* are dealt with in quite a lot of works on the biosynthesis of tropane alkaloids.

GUSEV (1973), studying tissue cultures produced from *Datura innoxia*, found that the origin of the callus tissues (root, stem, leaf, etc.) influences the growth of the biomass. Furthermore, it was observed that by increasing the number of transplantations the biomass production of the tissues also increases.

SMORODIN (1974) investigated the effect of various physical factors on the growth of *Datura innoxia* callus tissues (for example, the agar-concentration of the nutrient medium, its osmotic pressure, temperature).

BEREZNEGOVSKAYA and her co-workers (1978), as well as SMORODIN (1974), analysed the effect of saccharose concentration of the nutrient medium on tissue growth. They found

that the growth of tissues on a nutrient medium rich in saccharose (10%) is slow and the size of the cells is much smaller than that of the control tissues. If the saccharose concentration of the nutrient medium is gradually decreased, the size of the cells increases.

HIRAOKA (1974) substituted saccharose with other carbon sources. The 20 month-old callus tissues of *D. stramonium* grew best on glucose; the next were saccharose, mannose, maltose and fructose. According to his examinations, a 3% saccharose concentration in the callus cultures of *Datura innoxia*, proved to be optimal for both growth and alkaloid production.

Studying the effect of illumination on the callus tissues of seed origin in *Datura innoxia* STABA and JINDRA (1968) found that the tissues containing chlorophyll grew more rapidly. Similar findings were reached by BEREZNEGOVSKAYA (1978) in relation to *D. innoxia* callus tissues of leaf, petiole and seed origin. Furthermore, they observed that the biomass production of callus tissues is the most intensive at a light intensity of 3000 Lux. The effect of light on the young callus tissues of root and leaf origin and their alkaloid production was also studied (VERZÁR-PETRI, KIET and SZŐKE 1978). KIET's further inference was (1978) that callus tissues of root origin synthesize a greater amount of alkaloids in the dark, while those of leaf origin in light.
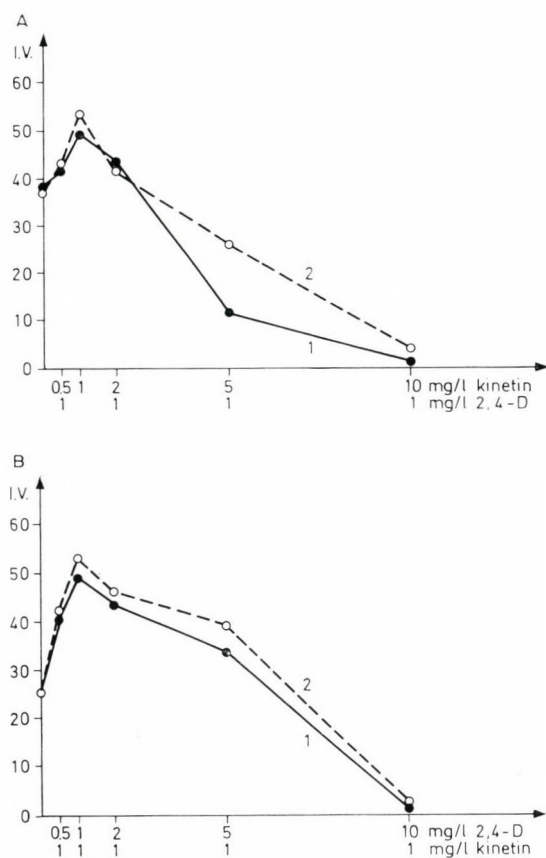
Fig. 1. Effect of the concentration of growth stimulator agents on the increase value (IV) of root callus tissues cultivated in dark. *1* IV expressed in fresh weight; *2* IV expressed in dry weight; *A* various kinetine concentrations; *B* various 2,4-D concentrations

The aim of this work is to analyse — beyond the illumination factor — the effect of cultivation time as well as the composition of the medium on the growth and alkaloid biosynthesizing capacity of the cultures with special regard to the concentration of the growth regulators. In the first part of our work the results of the investigations of the dynamics of growth will be given.

Material and method

Five-year-old callus tissues prepared from the leaves and roots of *Datura innoxia* MILL. were cultivated on modified Murashinge–Skoog basic medium (1 mg/l kinetine and 1 mg/l 2,4-D), at 26 °C, in dark and in light (2500 Lux), at a 70% relative humidity. The tissue were grafted to fresh nutrient medium every 4–5 weeks.
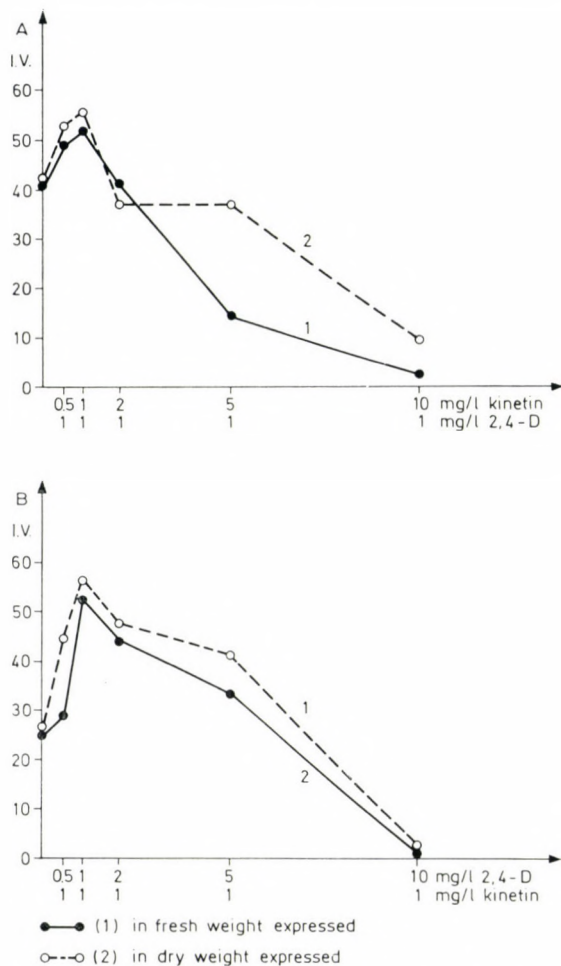
Fig. 2. Effect of the concentration of growth stimulator agents on the increase value (IV) of leaf callus tissues cultivated in dark. *1* IV expressed in fresh weight; *2* IV expressed in dry weight; *A* various kinetine concentrations; *B* various 2,4-D concentrations

For the investigations on the growth dynamics of tissue cultures and the effect of growth stimulators, the tissues were cultivated in biological test tubes. The experiments were repeated 20 times.

At the and of the cultivation period, the fresh and the dry weights of the callus were determined and the dry weights of the callus were determined in all the test tubes, and the results were statistically evaluated (GORDON 1976). For the characterization of the growth activity of the tissues, the same indices were used as were described in detail by SZŐKE and co-workers (1979) when they analysed the callus tissues of *Matricaria chamomilla* L., therefore it will not be described here.

For microscopical examinations squash preparations were used.

Results and evaluation

The callus tissues obtained from the roots and leaves of *Datura innoxia* MILL. cultivated in dark differ from one another only slightly. Both tissue cultures are yellowish, bone-coloured, homogeneous callus tissues, with no visible marks of organogenesis. The *Datura innoxia* MILL. tissue cultures grow well in both dark and light, however the leaf cultures reared in light became more dense. On analysing them light-microscopically, we observed that an excessive number of tracheids (water-conveying) cells had developed in them, growing singly more often in groups. Furthermore certain cells of the callus tissues of leaf origin contain a great number of chloroplasts causing the tissues to become intensively green. It is interesting to note that the tissues of root origin under light effect do not turn into green at all, or only to a very slight degree.

First the effect of the concentration of growth regulators on tissue growth activity was analysed so as to enable selecting the optimal hormone concentrations for the chemical examinations.

The growth results of (7 weeks old) callus tissues of root and leaf origin, grown in dark on basic nutrient medium at different auxine and kinetine concentrations, are demonstrated in Tables 1 and 2 (starting weight: 0.10 g). It appears from both tables and also from Figs 1 and 2 that the tissues grew most intensively at 1 mg/l dose of kinetine and 1 mg/l of 2,4-D. In lower or higher auxine and kinetine concentration (stable kinetine, and 2,4-D concentration), the tissues grew less intensively or almost not at all. With higher kinetine concentrations, the tissues became more dense, and their dry matter content increased significantly. No marks of organogenesis could be observed in any of the cases.

Since the most intensive growth could be observed at a dose of 1 mg/l kinetine and of 2,4-D, for therefore in further chemical analyses the callus tissues were primarily grown on such a basic nutrient medium. Before beginning our phytochemical analyses, it was necessary to known the number of weeks of cultivation needed for the tissues to reach their maximum weight. Therefore the growth dynamics analysis of the callus tissues of root and of

Table 1

Effect of growth stimulator agents, kinetine and 2,4-D, on the growth of root callus tissue of Datura innoxia

Serial number of experimental variants	Concentration (mg/l)		Callus fresh weight (g)	Callus dry weight (mg)	Dry-matter content (%)	Increase value (IV)		Growth rate (mg/day)
	kinetine	2,4-D				by fresh weight	by dry weight	
1	0	1	4.1979 ± 0.0056	137.27	3.27	37.91	37.24	83.47
2	0.5	1	4.5573 ± 0.0238	155.40	3.41	41.24	42.29	90.80
3	1	1	5.3997 ± 0.0203	193.85	3.59	49.04	53.00	107.99
4	2	1	4.4606 ± 0.0949	151.66	3.40	40.34	41.25	88.83
5	5	1	1.3197 ± 0.0083	95.94	7.27	11.23	25.72	24.73
6	10	1	0.2376 ± 0.0085	18.01	7.58	1.20	4.02	2.65
7	1	0	2.8753 ± 0.0654	95.75	3.33	25.65	25.67	56.48
8	1	0.5	4.5024 ± 0.1004	152.63	3.39	40.73	41.52	89.68
9	1	2	4.7825 ± 0.0929	166.43	3.48	43.32	45.36	95.40
10	1	5	3.7028 ± 0.0344	142.93	3.86	33.32	38.81	73.36
11	1	10	0.2075 ± 0.0085	11.06	5.33	0.92	2.08	2.03
12	0	10	0.1593 ± 0.0071	6.71	4.21	0.48	0.87	1.05

Table 2

Effect of growth stimulator agents, kinetine and 2,4-D, on the growth of leaf callus tissue of Datura innoxia

Serial number of experimental variants	Concentration (mg/l)		Callus fresh weight (g)	Callus dry weight (mg)	Dry-matter content (%)	Increase value (IV)		Growth rate (mg/day)
	kinetine	2,4-D				by fresh weight	by dry weight	
1	0	1	4.5573 ± 0.0238	151.32	3.32	40.69	42.24	90.8
2	0.5	1	5.5127 ± 0.0321	187.41	3.40	49.44	52.57	110.3
3	1	1	5.7901 ± 0.0509	198.00	3.42	51.97	55.57	115.9
4	2	1	4.6006 ± 0.0377	133.92	3.91	41.09	37.26	91.7
5	5	1	1.7889 ± 0.0178	133.63	7.47	15.37	37.17	34.3
6	10	1	0.5101 ± 0.0170	40.94	8.01	3.67	10.68	8.2
7	1	0	2.8666 ± 0.0601	94.91	3.32	25.57	26.11	56.3
8	1	0.5	4.6979 ± 0.0128	156.62	3.36	41.98	43.74	93.6
9	1	2	4.9015 ± 0.0099	169.05	3.45	43.84	47.40	97.8
10	1	5	3.7559 ± 0.0452	147.92	3.94	33.36	41.25	74.4
11	1	10	0.2403 ± 0.0040	13.01	5.41	1.20	2.71	2.7
12	0	10	0.2391 ± 0.0044	10.33	4.32	1.19	1.94	2.6

leaf origin — cultivated on basic cultures both in dark and in light — was carried out weekly.

The fresh and the dry weight of both callus tissues as well as their increase values increased regularly during a period of 8 weeks (Tables 3–6). In the 6–8th week of growth, the increase takes a decelerated course, or almost entirely stops. The aging of the tissues began.

It should be noted that up to the fifth week there is an essentially identical growth rate both in dark and in light. Beginning with the 5th week

Table 3

Growth dynamics of root callus tissue in Datura innoxia cultivated on the nutrient culture in dark

Incubation period (week)	Callus fresh weight (g)	Callus dry weight (mg)	Dry-matter content (%)	Increase value (IV)		Growth rate (mg/day)
				by fresh weight	by dry weight	
0	0.1079 ± 0.0025	3.59	3.33			
1	0.2893 ± 0.0043	15.97	5.52	1.6691	3.3088	25.90
2	0.6796 ± 0.0138	38.89	5.72	5.2696	9.4936	55.80
3	1.0798 ± 0.0186	50.85	4.71	8.9610	12.7207	57.20
4	1.7522 ± 0.0382	74.29	4.24	15.1643	19.0437	96.00
5	2.6008 ± 0.0338	106.89	4.41	22.9922	27.8611	121.20
6	4.5216 ± 0.0098	176.64	3.91	40.7117	46.6554	274.40
7	5.4917 ± 0.0309	198.47	3.61	49.6615	53.5346	138.60
8	5.4875 ± 0.0273	197.73	3.60	49.6213	53.3440	—0.60

Table 4

Growth dynamics of root callus tissue in Datura innoxia cultivated on basic nutrient culture, in light

Incubation peri d (we k)	Callus fresh weight (g)	Callus dry weight (mg)	Dry-matter content (%)	Increase value (IV)		Growth rate (mg/day)
				by fresh weight	by dry weight	
0	0.1084 ± 0.0025	3.70	3.42			
1	0.2404 ± 0.0042	13.04	5.42	1.2179	2.5177	18.60
2	0.5566 ± 0.0312	31.28	5.62	4.1242	7.4385	45.20
3	1.0324 ± 0.0345	55.86	5.41	8.5243	14.0688	68.00
4	1.7894 ± 0.0188	85.89	4.80	15.5071	22.1716	108.10
5	2.7866 ± 0.0185	128.37	4.61	24.7067	33.6320	142.40
6	3.1839 ± 0.0178	137.44	4.32	28.3718	36.0792	56.80
7	3.3861 ± 0.0097	139.55	4.00	30.2371	35.5713	28.90
8	3.4980 ± 0.0062	135.60	3.88	31.2698	35.5847	16.00

Table 5

Growth dynamics of leaf callus tissue in Datura innoxia cultivated of basic nutrient culture, in dark

Incubation period (week)	Callus fresh weight (g)	Callus dry weight (mg)	Dry-matter content (%)	Increase value (IV)		Growth rate (mg/day)
				by fresh weight	by dry weight	
0	0.1093 ± 0.0018	3.47	3.20			
1	0.5265 ± 0.0047	27.70	5.23	3.82	6.98	59.60
2	0.8134 ± 0.0087	38.60	4.74	6.44	10.12	41.00
3	1.2968 ± 0.0269	59.70	4.55	10.86	16.20	69.10
4	1.5993 ± 0.0219	58.10	3.62	13.63	15.74	43.20
5	2.7181 ± 0.0279	95.50	3.52	23.87	26.53	15.98
6	4.6510 ± 0.0041	162.70	3.50	41.55	45.89	276.10
7	5.8376 ± 0.0117	195.70	3.36	52.41	55.40	169.50
8	5.6053 ± 0.0037	170.40	3.04	50.28	48.19	—33.2

Table 6

Growth dynamics of leaf callus tissue in Datura innoxia cultivated on basic nutrient culture, in light

Incubation period (week)	Callus fresh weight (g)	Callus dry weight (mg)	Dry-matter content (%)	Increase value (IV)		Growth rate (mg/day)
				by fresh weight	by dry weight	
0	0.0984 ± 0.0043	3.13	3.35			
1	0.3073 ± 0.0061	17.09	5.56	2.12	4.45	29.80
2	0.6766 ± 0.0085	36.03	5.27	5.87	10.49	52.80
3	0.7986 ± 0.0092	35.36	4.42	7.12	10.28	17.40
4	1.3187 ± 0.0083	55.98	4.26	12.40	16.86	74.30
5	2.5486 ± 0.0461	101.00	4.04	24.90	31.23	175.70
6	3.9032 ± 0.0068	148.60	3.81	38.67	46.42	193.50
7	4.9012 ± 0.0099	170.50	3.47	48.81	53.40	142.60
8	5.2019 ± 0.0107	172.00	3.31	51.86	53.88	43.00

however it decelerates in the cultures grown in light (Tables 4 and 6). The daily growth of the tissues calculated every week did not however change as evenly as that.

It is interesting to note that the root callus tissue grown in light takes an essentially worse course of growth (the increase value of an 8-week-old tissue is 35.5 taking the dry weight as the basis than that grown in dark (GV 53.3). At the same time, leaf callus tissues growth is less intensive in

dark (IV 48.2) than in light (IV 53.9), but the difference is not so marked as in the case of root tissues.

The dry-matter content of the tissues (%) changed regularly, whether they were grown in dark or in light (Tables 3–6). It rose abruptly in the first week of development due to the strong meristematic activity of the tissues in this period. In the 2nd and 3rd weeks of development, the dry-matter content of the tissues is still relatively high, but from the 3rd–4th weeks, when the tissue growth becomes more intensive, the water content of the tissues increases, which is probably connected with the increase coming about as a result of the vacuolation and elongation of the cells.

Comparing the dry-matter contents of the callus tissues of different origins the dry-matter content of the root tissues was found to have a higher value than that of the leaf-tissues. Light factors also influence the dry-matter content of the tissues. In the case of both callus tissues, the dry-matter content of the tissues grown in light is higher than that of tissues cultivated in dark. This has been confirmed by the light microscopic examinations mentioned above. The tissues cultivated in light became more dense and a great number of tracheids became differentiated in them.

The growth indices of *Datura innoxia* Mill. callus tissues taken into cultures indicated that homogeneous cultures could be produced which grow satisfactorily.

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Acta Botanica Academiae Scientiarum Hungaricae, Vol. 27 (3—4), pp. 335—349 (1981)

A SHORT SURVEY OF THE RUDERAL PLANT COMMUNITIES OF WESTERN SLOVAKIA

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(Received: February 25, 1980)

Short characteristics of the plant nitrophilous communities occurring in Western Slovakia, Czechoslovakia, are presented in the form of the first syntaxonomical survey. The survey contains about 90 ruderal associations belonging to the classes *Bidentetea tripartiti* Tx., LOHMEYER et PREISING in Tx. 1950, *Sisymbrietea officinalis* GUTTE et HILBIG 1975 em., *Meliloto-Artemisietea absinthii* ELIÁŠ 1980, *Artemisietea vulgaris* LOHMEYER, PREISING et Tx. in Tx. 1950, *Agropyretea repentis* OBERDORFER, TH. MÜLLER et GÖRS in OBERD. et al. 1967, *Polygono-Poetea annuae* RIVAS-MARTÍNEZ 1975 and *Molinio-Arrhenatheretea* Tx. 1937 em. 1970.

Introduction

Ruderal plant communities represent a specified group of plant cenoses in cultural (anthropogenic) landscape. They are secondary, anthropogenic communities from the group of the synanthropic communities being a product of human activity in nature. These man-made natural communities usually required relatively nutrient-rich soils, especially in nitrogen compounds. They are considered to be more or less nitrophilous communities forming by hemerophytes, i.e. such plant species which are positively influenced by human activity (it is manifested by larger spreading of the species, by forming new stands, etc.). They are formed by both natives and introduced species, but adventitious and naturalized species frequently prevailed. Many of them are native in America or Asia and have been naturalized in Europe.

Ruderal communities growing in areas disturbed by man have adapted to several forms of human activity such as trampling, mechanical damage, etc. Ruderal communities have been grown in several artificial, man-made habitats (ecotopes or "sociotopes") which may be grouped into several habitat types differing by the effects of both anthropic and natural factors. In the investigated region, we distinguished on the basis of unifying ecological factors the following fundamental habitat groups:

1. Trampled (trodden) habitats
2. Railway-yard habitats
3. Ruderal habitats
   a) ruderal habitats enriched by solid (organic and inorganic) refuses
   b) ruderal habitats enriched by liquid refuses and discharges
   c) ruderal habitats enriched by inorganic solid waste material from ore-mines and coal-mines and works
4. Embankment habitats

5. Ruined area habitats
6. Abandoned-area habitats
7. Arable-area habitats

The habitats of ruderal communities occur in cultural landscapes in the forms of several sets which are considered by landscape ecologists as structural landscape units. Villages, towns, cities and other man-made ecosystems are represented by complexes of many different kinds of anthropogenic habitats (cf. ELIÁŠ 1981). In rural settlements, several ruderal and trampled habitats frequently and typically occur. In urban ecosystems all distinguished habitat groups are presented.

Brief ecological characteristics of the study region

Western Slovakia is considered in this paper to be the administrative region Západoslovenský kraj (Fig. 1). It extends between 47° 44′ to 49° 03′ N lat. and 16° 49′ to 19° 04′ E long (Central Europe). The region area is 14,860 km², i.e. 11.6 per cent of the total area of Czechoslovakia.

The Západoslovenský kraj land has a lowland character. Hills and mountains occur only in the northern part of the region. The lowest point of the region (102 m alt.) lies at the confluence of the rivers Ipeľ and Dunaj (Danube). The highest point is 1042 m (Mt Inovec) Považský Inovec Mts. The region is formed by two large and different orographical and geological units: Pannonian (Carpathian) Basin and West Carpathians. The largest area of the region comprises of lowlands and hills of the Pannonian Basin. All the southern and central parts of the region belong to the Podunajská nížina (Danubian Lowlands).

Western Slovakia lies in the transitional zone between maritime (oceanic) and continental climate. Compared with the European-continental climatic zone, the climate of the Pannonian Basin is in general less continental with about the same summer temperatures but much milder winters and high precipitations. Southern Slovakia, especially Podunajská rovina region, is considered to be the warmest and driest region of Czechoslovakia (cf. PETROVIČ 1968).

The largest part of Western Slovakia belongs to the Pannonical Province (Pannonicum) of the Pontic-South Siberian Region, which is the phytogeographical region of Central and East European thermophilous flora. Mountains of the West Carpathians belong to the Carpathian Subregion (Carpaticum).

Western Slovakia is made up of agricultural fields, vineyards, orchards and grasslands. Natural vegetation was represented by several forests occurring only in mountains and hills as well as in the inundation areas of the Danube.
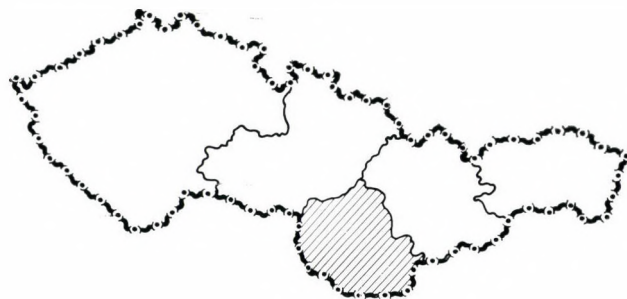
Fig. 1. Location of the investigated region Západoslovenský kraj in Czechoslovakia

Survey of the ruderal communities

The survey of the ruderal communities occurring in Western Slovakia is primarily a survey of the synanthropic vegetation of the region in the eastern part of Czechoslovakia. The classification of the ruderal vegetation is similar to that used in surveying the ruderal communities of Slovak lowlands and Innercarpathian Basins (see ELIÁŠ 1979b). It differs partly from the survey of ruderal communities of Czechoslovakia published by HEJNÝ, KOPECKÝ, JEHLIK and KRIPPELOVÁ (1979). Our survey has been compiled on the basis of phytocenological material published from the territory of Western Slovakia. It also accepts published material from other parts of Slovakia (Central and Eastern Slovakia). It is an attempt to make a new classification of the thermo-xerophytic ruderal and semiruderal communities of Central Europe, taking into account published phytocenological material from other territories of the Pannonian region (including Hungary, Yugoslavia and Rumania).

The survey by its nature is connected to the survey of plant communities published by SOÓ (1961, 1971) for the whole Pannonian region. Ruderal vegetation is classified into associations which are grouped into higher-ranking units according to the principles of the Zürich–Montpellier school of vegetation classification.

The following abbreviations occur in naming of the syntaxa:

em. — emendatio, change in the original range of syntaxonomical unit
s. l. — sensu lato
s. str. — sensu stricto
syn. — synonymum
n. n. — nomen nudum
n. nov. — nomen novum
p. p. — pro parte
bas. — basionymum

I. Class **BIDENTETEA TRIPARTITI** TX., LOHMEYER et PREISING in TX. 1950

A. Order BIDENTETALIA TRIPARTITI BR.-BL. et TX. 1943

1. Alliance ***Bidention tripartiti*** NORDHAGEN 1940

Associations:

1. **Ranunculo scelerati-Rumicetum maritimi** SISSINGH (1946) 1966
2. **Bidentetum tripartiti** W. KOCH 1926 em. HEJNÝ in HEJNÝ et al. 1979
3. **Pulicario vulgaris-Bidentetum** (AMBROŽ 1939) HEJNÝ in HEJNÝ et HUSÁK 1978
4. **Echinochloo-Polygonetum** SOÓ et CSŰRÖS 1947

II. Class **SISYMBRIETEA** GUTTE et HILBIG 1975 em. ELIÁŠ 1980

Syn.: *Onopordo-Sisymbrietea* GÖRS 1966 p. p., *Sisymbrio-Onopordetea* (BR.-BL. 1964) GÖRS 1966 em. ELIÁŠ 1979, order *Sisymbrietalia* J. TÜXEN ex MATUSZKIEVICZ 1962, *Sisymbrietea* GÖRS ex KORNECK 1974 nom. nov.

A. Order SISYMBRIETALIA J. TÜXEN ex MATUSZKIEWICZ 1962 em.

1. Alliance ***Chenopodion glauci*** HEJNÝ 1974

Associations:

1. **Chenopodietum glauco-rubri** LOHMEYER in OBERDORFER 1957

Syn.: *Chenopodietum rubri* TIMÁR 1950 p. p., *Chenopodietum rubri* UBRIZSY 1949 n. n.

2. **Chenopodietum ficifolii** HEJNÝ in HEJNÝ et al. 1979

2. Alliance ***Malvion neglectae*** (GUTTE 1972) HEJNÝ 1978

Syn.: Suballiance *Malvion neglectae* GUTTE 1972

Associations:

1. **Malvetum pusillae** MORARIU 1943
2. **Malvetum neglectae** FELFÖLDY 1942

Syn.: *Urtico-Malvetum neglectae* (KNAPP 1945) LOHMEYER in TX. 1950, *Hyoscyamus niger-Malva neglecta*-Ass. AICHINGER 1933 p. p.

Nomenclatural type (lectotype): FELFÖLDY 1942, Tab. 11, Relevé No. 1.

Subassociations:

— *typicum* HEJNÝ 1978

— *chenopodietosum vulvariae* (GUTTE 1972) HEJNÝ 1978 em.

(Syn.: *Chenopodio vulvariae-Malvetum neglectae* GUTTE 1972, *Chenopodietum vulvariae* GUTTE et PYŠEK 1976 *Malva*-Subassoziation)

— *amaranthetosum crispi* (MITITELU 1972) ELIÁŠ hoc loco

(Syn.: *Amaranthetum crispi* MITITELU 1972 p. p.)

3. **Daturo-Malvetum** (ATHENSTADT 1941) LOHMEYER in TX. 1950

Subassociations:

— *typicum* ELIÁŠ 1980

— *xanthietosum strumariae* ELIÁŠ hoc loco

The following relevé documents the subassociation:
Data and location: June 9, 1976; Báb-Alexandrov Dvor (Horný Majer).
Area: 7.5 m². Cover degree: 80%.
Xanthium strumarium 4, *Malva neglecta* 1, *Urtica urens* 1, *Datura stramonium* +, *Polygonum aviculare* 1, *Capsella bursa-pastoris* +, *Diplotaxis tenuifolius* +, *Sisymbrion irio* r—+, *Descurainia sophia* r—+, *Raphanus raphanistrum* +, *Leonurus cardiaca* +, *Ballota nigra* +, (*Arctium lappa* +), *Fumaria officinalis* r, *Matricaria discoidea* r, *Lepidium ruderale* r.

4. **Chenopodietum vulvariae** GUTTE et PYŠEK 1976 em.

Syn.: *Chenopodietum vulvariae* GUTTE et PYŠEK 1976, Typische-Subassoziation.

Nomenclatural type (lectotype): GUTTE and PYŠEK 1976, Tab. 1b, Relevé No. 68.

5. **Chenopodietum muralis** BR.-BL. 1936

Syn.: *Chenopodio vulvariae-muralis-Urticetum urentis* SOÓ 1971 n. n.

3. Alliance ***Bromo-Hordeion murini*** HEJNÝ 1978

Syn.: *Bromion tectorum* SOÓ 1940 p. p.

Associations:

1. **Hordeetum murini** LIBBERT 1932 em. ELIÁŠ 1979

Syn.: Ass. *Hordeum murinum-Bromus sterilis* (ALLORGE 1922) LOHMEYER in TX. 1950, *Bromo-Hordeetum* auct. div.

Subassociations:

— *typicum* TX. et SISSINGH ex SISSINGH 1950
— *brometosum sterilis* ELIÁŠ 1979
— *brometosum tectorum* (GUTTE 1971) ELIÁŠ 1979
— *sisymbrietosum loeselii* ELIÁŠ (1977) 1979

2. **Brometum sterilis** GÖRS 1966
3. **Bromo sterilis-Asperuginetum procumbentis** ELIÁŠ hoc loco

Indicating group of species: *Asperugo procumbens*, *Bromus sterilis*, *Galium aparine*, *Atriplex tatarica*, *Cardaria draba*.

Spring ephemerous annual community of loose and bare anthropogenic soils.

A specimen vegetation relevé documents the association. Data and location: May 13, 1974; Richterov Dvor near Trnava (Danubian Lowlands). Area: 9 m². Cover degree: 100%. Stand height: 0.4 m.
E_2: *Robinia pseudacacia* 1
E_1: *Asperugo procumbens* 5, *Bromus sterilis* 1, *Cardaria draba* +, *Anthriscus cerefolia* +, *Descurainia sophia* r, *Ballota nigra* +, *Arctium lappa* r—+, *Silene alba* r, *Thlaspi arvense* r, *Taraxacum officinale* r.

4. **Linario-Brometum tectorum** KNAPP 1961
5. **Brometum tectorum** BOJKO 1934

4. Alliance ***Sisymbrion officinalis*** TX., LOHMEYER et PREISING in TX. 1950 em. HEJNÝ in HEJNÝ et al. 1979

Syn.: *Atriplici-Sisymbrion* HEJNÝ 1978, *Atriplicion* HEJNÝ ex PASSARGE 1978 p. p.

Associations:

1. **Sisymbrietum sophiae** KREH 1935

Syn.: *Sisymbrietum loesellii* GUTTE 1972 nom. nov. p. p.

Subassociations:

— *typicum* ELIÁŠ 1979
— *sisymbrietosum loeselii* ELIÁŠ 1979

(Syn.: *Sisymbrietum loeselii* GUTTE 1972 p. p.)

2. **Sisymbrietum loeselii** GUTTE in ROSTANSKI et GUTTE 1971 em. ELIÁŠ 1979

Syn.: *Sisymbrietum loeselii* GUTTE in ROSTANSKI et GUTTE 1971 p. p.

3. **Bromo tectori-Sisymbrietum orientalis** ELIÁŠ (1977) 1979

Syn.: *Sisymbrietum orientale* ELIÁŠ 1977

4. **Chenopodietum stricti** OBERDORFER 1957

Bas.: *Chenopodietum ruderale* OBERDORFER 1957

Subassociations:

— *typicum* OBERDORFER 1957
— *daturetosum stramonium* OBERDORFER 1957
— *chenopodietosum ficifolii* GRÜLL

5. **Atriplicetum nitentis** KNAPP 1945

Syn.: *Sisymbrio-Atriplicetum nitentis* (KNAPP 1945) OBERDORFER 1957

6. **Atriplicetum tataricae** UBRIZSY 1949

Syn.: *Atriplex tatarica-Cynodon dactylon*-Ass. MORARIU 1943 p. p., *Hordeum murinum-Atriplex tatarica*-Ass. (FELFÖLDY 1942) TX. 1950 p. p.

Subassociations:

— *typicum* KRIPPELOVÁ 1981
— *atriplicetosum acuminatae* SOÓ 1971
(Syn.: *Atriplicetum nitentis* SLAVNIĆ 1951, non *Atriplicetum nitentis* KNAPP 1945)
— *puccinellietosum* KRIPPELOVÁ 1981
— *cynodontetosum* ELIÁŠ 1980

7. **Erigeronto-Lactucetum** LOHMEYER in OBERDORFER 1957
8. **Sisymbrio-Atriplicetum oblongifoliae** OBERDORFER 1957
9. **Ivaetum xanthiifoliae** FIJALKOWSKI 1967
10. **Artemisietum annuae** FIJALKOWSKI 1967

Syn.: sociata *Artemisia annua* MORARIU 1943, *Artemisietum annuae* TODOR, GERGELY et BARCA 1971

5. Alliance ***Salsolion ruthenicae*** PHILIPPI 1971

Associations:

1. **Bromo-Corispermetum leptopteri** SISSINGH 1959 em. KORNECK 1974

Syn.: *Salsola ruthenica-Corispermum leptopteri* (SISSINGH 1950) KORNECK 1974

Subassociations:

— *typicum* KORNECK 1974
— *tragetosum racemosi* KORNECK 1974

2. **Plantaginetum indicae** PHILIPPI 1971
3. **Plantagini indicae-Tragetum racemosi** ELIÁŠ 1978
Nomenclatural type: ELIÁŠ (1978a: 77), Tab. 15, Relevé No. 1
4. **Chenopodietum botryos** SUKOPP 1971

B. Order ONOPORDETALIA ACANTHII BR.-BL. et TX. 1943 em. ELIÁŠ 1979

1. Alliance ***Onopordion acanthii*** BR.-BL. 1926 s. str.

(non *Onopordion acanthii* sensu HEJNÝ et al. 1979)

Associations:

1. **Onopordetum acanthii** BR.-BL. 1926

Subassociations:

— *typicum* Soó 1971
— *carduetosum acanthoidis* Soó 1971

2. **Carduetum acanthoidis** MORARIU (1939) 1943

Syn.: *Carduus acanthoides*-Ass. FELFÖLDY 1942

3. **Xanthietum spinosi** FELFÖLDY 1942

Syn.: *Xanthium spinosum-Xanthium strumarium*-Ass. PAUCA 1941 p. p., *Amaranthus retroflexus-Xanthium spinosum*-Ass. MORARIU 1943 p. p.

4. **Lappulo echinatae-Cynoglossetum** KLIKA 1935

Syn.: *Lappulo-Asperuginetum* UBRIZSY 1949

III. Class **MELILOTO-ARTEMISIETEA ABSINTHII** ELIÁŠ 1980

Syn.: *Onopordetea acanthii* BR.-BL. 1964 em. ELIÁŠ 1979 p. p., *Artemisietea vulgaris* LOHMEYER, PREISING et TX. in TX. 1950 em. KOPECKÝ in HEJNÝ et al. 1979 p. p.

Thermo-xerophilous, little nitrophilous ruderal and semi-ruderal communities of biennials and perennials growing in semi-natural and/or anthropogenic habitats exposed to sunlight. Absence of several mesophilous and strong nitrophilous species is typical for the communities of the class. On the other side, xerothermophytes from the class *Festuco-Brometea* BR.-BL. et TX. 1943 frequently occur in the communities.

A. Order MELILOTO-ARTEMISIETALIA ABSINTHII Eliáš 1979

The communities of drying and dry or pervious anthropogenic and/or semi-natural soils, usually poor in nitrogen-compounds and humus, formed by biennial and perennial herbs. Indicating group of species is formed by *Berteroa incana*, *Melilotus officinalis*, *Reseda lutea*, *Artemisia absinthium*, *Echium vulgare*, *Linaria vulgaris*, *Verbascum densiflorum*, *Carduus acanthoides*, *Anchussa officinalis*, *Artemisia campestris*, *Chondrilla juncea*, *Hypericum perforatum*, *Salvia verticillata*, *Arenaria serpyllifolia* and other character species of the class *Festuco-Brometea* and *Sedo-Scleranthetea* (e.g. *Euphorbia cyparisias*, *Eryngium campestre*, *Centaurea stoebe*, *Plantago lanceolata*, *Medicago falcata*, *Coronilla varia*, *Poa angustifolia*, *Sanguisorba minor*, etc.).

1. Alliance ***Dauco-Melilotion albi*** Görs 1966 em. Eliáš 1980

Associations:

1. **Melilotetum albae-officinalis** Sissingh 1950

   Syn.: *Echio-Melilotetum albi* Tx. 1942

   Subassociations:

— *typicum* Passarge 1977
— *melilotetosum* Passarge 1977

2. **Artemisio-Oenotheretum rubricaulis** Passarge 1977
3. **Epilobio dodonaei-Melilotetum albi** Slavik 1978
4. **Echio-Verbascetum** Sissingh 1950
5. **Berteroetum incanae** Sissingh et Tideman ex Sissingh 1950
6. **Dauco-Picridetum** Görs 1966
7. **Dauco-Crepidetum rhoedifoliae** Hejný et Grull in Hejný et al. 1979

2. Alliance ***Potentillo-Artemision absinthii*** Eliáš (1979) 1980

Syn.: *Artemision absinthii* Eliáš 1979, non *Artemision absinthii* Lukasić et al. 1978

Thermophilous ruderal and semiruderal communities growing on drying, loamy soils in cultural landscape. The habitats may be classified as embankment habitats and abandoned habitats with loamy and sandy-loamy soils. In North Europe it occurs frequently on dry, pervious substrates (sandy and gravely soils). Indicating the group of species is formed by *Artemisia absinthium*, *Echinops sphaerocephalus*, *Artemisia campestris*, *Potentilla argentea*, *Agropyron intermedium*, *Tragopogon dubius*, *Alyssum alyssoides*, *Potentilla intermedia*. Some communities of the alliance are closely related to the alliance *Onopordion acanthii* and *Arction lappae*. Several transitional cenoses between *Artemision absinthii* and other syntaxa occur. The alliance contains several communities (associations) described from both anthropogenic and semi-natural habitats (cf. Braun-Blanquet 1961, Falinski 1965, Pop 1970, Todor, Gergely et Barca 1971).

1. **Potentillo argenteae-Artemisietum absinthii** FALINSKI 1965

Bas.: *Potentillo argenteae-Absinthietum* FALINSKI 1965 prov.

Nomenclatural type (lectotype): FALINSKI (1965), Tab. 1, Column No. 10 (1 relevé from Czerlonka).

Subassociations:

— *typicum* ELIÁŠ 1980
— *berteroetosum incanae* ELIÁŠ hoc loco
(Nomenclatural type: FALINSKI et BARTEL (1965), Tab. 8, Relevé No. 4)

Differential species: *Berteroa incana*, *Oenothera biennis*, *Melilotus alba*.

— *carduetosum acanthoidis* ELIÁŠ 1980

Differential species: *Carduus acanthoides*, *Verbascum phlomoides*, *Reseda lutea*, *Cirsium lanceolatum*.

— *polygonetosum avicularis* ELIÁŠ 1973
[Nomenclatural type: ELIÁŠ (1973), Tab. 1, Relevé 6o. 5]

3. Alliance ***Marrubion peregrini*** SLAVNIĆ 1951 em. ELIÁŠ 1980

Nomenclatural type: *Marrubio peregrini-Centauretum spinulosae* SLAVNIĆ 1951

Association:

1. **Marrubio peregrini-Salvietum nemorosae** ELIÁŠ 1980

Indicating group of species: *Salvia nemorosa*, *Marrubium peregrinum*, *Carduus acanthoides*, *Reseda luteola*, *Artemisia absinthium*, *Matricaria chamomilla*, *Cardaria draba*, *Plantago lanceolata*, *Poa angustifolia*, *Achillea millefolium*, *Verbascum densiflorum*, *Artemisia vulgaris*, *Ballota nigra* subsp. *nigra*.

Early summer semi-ruderal community of open, sunny, dry loess slopes. It occurs usually on raw loess soils disturbed by water erosion in cultural landscape, rarely on black soils. The habitats may be classified as embankment habitats and abandoned habitats. Community of the second successional stage.

A specimen vegetation relevé documents the association. Data and location: June 23, 1977; Báb-Veľký near Nitra (Danubian Lowlands), loess slopes above roads to village at cemetery. Exposition and inclination: S; 15°. Area: 10 m². Cover degree: 100%.
Salvia nemorosa 3, *Marrubium peregrinum* 2, *Poa angustifolia* 2, *Medicago falcata* 2, *Artemisia absinthium* 1—2, *Eryngium campestre* 1, *Carduus acanthoides* +—1, *Ballota nigra* subsp. *nigra* +—1, *Berteroa incana* +, *Plantago lanceolata* +, *Achillea millefolium* +, *Centaurea stoebe* +, *Hypericum perforatum* +, *Agrimonia eupatoria* +, *Galium verum* s. l. +, *Torilis japonica* +, *Lactuca serriola* r, *Bromus tectorum* r, *Dactylis glomerata* r, *Artemisia vulgaris* r, *Libanotis montana* r.

IV. Class **ARTEMISIETEA VULGARIS** Lohmeyer, Preising et Tx. in Tx. 1950 em.

Syn.: *Galio-Urticetea* Passarge 1967 em. Kopecký 1969

A. Order GALIO-ALLIARIETALIA (Tx. 1967) Görs et Th. Müller 1969

1. Alliance ***Galio-Alliarion*** Lohmeyer et Oberdorfer in Oberd. et al. 1967

Syn.: *Alliarion petiolatae* (Oberdorfer) Hejný in Holub et al. 1967, *Geo-Alliarion* Görs et Th. Müller 1969 nom. nov.

Associations:

1. **Anthriscetum cerefolii-trichospermae** Hejný et Krippelová in Hejný et al. 1979
2. **Epilobio-Geranietum robertiani** Lohmeyer ex Görs et Th. Müller 1969
3. **Torilidetum japonicae** Lohmeyer ex Görs et Th. Müller 1969
4. **Chaerophyllo-Geranietum lucidi** Oberdorfer 1957

2. Alliance ***Aegopodion podagrariae*** Tx. 1967 em. Hilbig, Heinrich et Niemann 1972

Associations:

1. **Anthriscetum sylvestris** Hadac 1978
2. **Chaerophylletum aromatici** Z. et R. Neuhäusel et Hejný 1969
3. **Agropyro repentis-Aegopodietum podagrariae** Tx. 1967
4. **Chenopodio-Rumicetum obtusifolii** Oberdorfer 1957

B. Order ARTEMISIETALIA VULGARIS Lohmeyer ex Tx. 1947 em. Eliáš 1979

1. Alliance ***Sambucion ebuli*** Eliáš 1979

Tall-herb, little to moderately nitrophytic, anthropogenic communities growing in embankment and abandoned habitats within the cultural landscape. Some of them occur also in clearings. Indication group of species is formed by *Sambucus ebulus*, *Urtica dioica*, *Artemisia vulgaris*, *Agropyron repens*, *Galium aparine*, *Convolvulus arvensis*, *Carduus acanthoides*. The associations *Urtico-Sambucetum ebuli* Br.-Bl. 1952 and *Parietario diffusae-Urticetum diocae* (Horvatić 1963) Eliáš 1979 occur in southern Europe. The following associations occur in Western Slovakia:

1. **Artemisio-Sambucetum ebuli** (Felföldy 1942) Eliáš 1979

Syn.: *Sambucetum ebuli* Felföldy 1942, non *Sambucus ebulus*-Ass. Kaiser 1926.

Nomenclatural type: Felföldy (1942), Tab. 7, Relevé No. 2.

Subassociations:

— *typicum* ELIÁŠ (1978) 1979

(Syn.: *Sambucetum ebuli typicum* ELIÁŠ 1978)

— *brometosum tectorum* (HEJNÝ 1979) ELIÁŠ hoc loco

(Syn.: *Sambucetum ebuli brometosum tectorum* HEJNÝ in HEJNÝ et al. 1979)

2. **Bromo inermis-Sambucetum ebuli** ELIÁŠ (1978) 1979

Syn.: *Sambucetum ebuli brometosum inermis* ELIÁŠ 1978

Nomenclatural type: ELIÁŠ (1978b), Tab. 2, Relevé No. 5.

3. **Sambucetum ebuli** KAISER 1926 em. ELIÁŠ 1979

Indicating group of species: *Sambucus ebulus, Epilobium angustifolium, Atropa belladonna, Eupatorium cannabinum* and some other mesophytic species.

Late summer mesophytic community of tall, perennial herbs growing in clearings and forest margins.

2. Alliance ***Arction lappae*** Tx. 1937 em. ELIÁŠ 1979

Associations:

1. **Lappo-Ballotetum nigrae** (FELFÖLDY 1942) MORARIU 1943

Syn.: *Arctium lappa*-Ass. FELFÖLDY 1942, *Lappa-Ballota*-Ass. MORARIU 1943, *Leonuro-Arctietum tomentosi* (FELFÖLDY 1942) LOHMEYER in Tx. 1950, *Arctio-Ballotetum nigrae* BR.-BL. et DE LEEW 1936 em. UBRIZSY 1949 sensu KRIPPELOVÁ 1972.

Nomenclatural type: MORARIU (1943), Relevé No. 2 on p. 171.

Subassociations:

— *typicum* ELIÁŠ hoc loco

— *conietosum maculati* ELIÁŠ hoc loco

(Syn.: *Arctio-Ballotetum nigrae* BR.-BL. et DE LEEW 1936 em. UBRIZSY 1949 *conietosum* KRIPPELOVÁ 1972)

Nomenclatural type: MORARIU (1943), Relevé No. 1 on p. 171.

2. **Lamio-Conietum maculati** OBERDORFER 1957
3. **Chenopodio boni-henrici-Ballotetum nigrae** LOHMEYER ex ROCHOW 1951
4. **Tanaceto-Artemisietum vulgaris** BR.-BL. 1949

Subassociations:

— *typicum* SISSINGH 1950

— *carduetosum acanthoidis* JEHLÍK in HEJNÝ et al. 1979

5. **Artemisio-Echinopsetum sphaerocephali** ELIÁŠ 1979

V. Class **AGROPYRETEA REPENTIS** OBERDORFER, TH. MÜLLER et GÖRS in OBERDORFER et al. 1967

A. Order AGROPYRETALIA REPENTIS OBERDORFER, TH. MÜLLER et GÖRS in OBERDORFER et al. 1967

1. Alliance ***Convolvulo-Agropyrion*** GÖRS 1966

Associations:

1. **Agropyretum repentis** FELFÖLDY 1942

Syn.: *Agropyron repens-Convolvulus arvensis*-Ass. FELFÖLDY 1943.

Subassociations:

— *typicum* GRIGORE 1971
— *calamagrostietosum epigei* KOPECKÝ in HEJNÝ et al. 1979

2. **Lepidietum drabae** TIMÁR 1950
3. **Falcario vulgaris-Agropyretum repentis** TH. MULLER et GÖRS 1969
4. **Melico transilvanicae-Agropyretum** TH. MULLER in GÖRS 1966
5. **Convolvulo-Brometum inermis** ELIÁŠ 1979
6. **Poo compressae-Tussilaginetum farfarae** TX. 1931

Syn.: *Tussilaginetum farfarae* OBERDORFER 1949

2. Alliance ***Convolvulo-Cynodontion dactyloni*** ELIÁŠ 1979

Association:

1. **Conyzo-Cynodontetum dactyloni** (FELFÖLDY 1942) ELIÁŠ 1978

Syn.: *Cynodontetum dactyloni* FELFÖLDY 1942 em. ELIÁŠ ex HEJNÝ et al. 1979, *Cynodon dactylon*-Ass. FELFÖLDY 1942 p. p., non *Cynodontetum dactyli* BOJKO 1933.

VI. Class **POLYGONO-POETEA ANNUAE** RIVAS-MARTINEZ 1975

Syn.: *Plantaginetea majoris* TX. et PREISING in TX. 1950 p. p.

A. Order POLYGONO AVICULARIS-POETALIA ANNUAE TX. in GEHU, RICHARD et TX. 1972

1. Alliance ***Polygonion avicularis*** BR.-BL. 1931 em. RIVAS-MARTINEZ 1975

Syn.: *Matricario-Polygonion avicularis* (BR.-BL. 1931) RIVAS-MARTINEZ 1975

Associations:

1. **Polygonetum avicularis** GAMS 1927 em. JEHLÍK in HEJNÝ et al. 1979

Syn.: *Plantagini-Polygonetum avicularis* (KNAPP 1945) PASSARGE 1964, *Lolio-Plantaginetum majoris* BEGER 1931 stadium *Polygonum aviculare* KRIPPELOVÁ 1972,

Matricario-Polygonetum avicularis (KNAPP 1946) TH. MÜLLER ex OBERDORFER 1971, *Polygono-Matricarietum matricarioidis* (SISSINGH 1969) TX. 1972.

2. **Eragostio-Polygonetum avicularis** OBERDORFER 1954
3. **Poetum annuae** GAMS 1927

Syn.: *Poa annua*-Ass. FELFÖLDY 1942, *Poetum annuae* KNAPP 1945, *Lolio-Plantaginetum poetosum annuae* KRIPPELOVÁ 1972 p. p.

4. **Herniarietum glabrae** (HOHENSTER 1960) HEJNÝ et JEHLÍK 1975

Syn.: *Lolio-Plantaginetum majoris* BEGER 1930 *herniarietosum glabrae* HOHENSTER 1960.

2. Alliance ***Saginion procumbentis*** TX. et OHBA in GEHU, RICHARD et TX. 1972

Association:

1. **Sagino-Bryetum argentei** DIEMONT, SISSINGH et WESTHOFF 1940

3. Alliance ***Sclerochloo-Coronopion squamati*** RIVAS-MARTINEZ 1975

1. **Sclerochloo-Polygonetum avicularis** SOÓ ex KORNECK 1969

Syn.: *Sclerochloo-Polygonetum avicularis* (GAMS 1927) SOÓ 1940

2. **Poo-Coronopetum squamati** (OBERDORFER 1957) GUTTE 1966

Syn.: *Lolio-Plantaginetum majoris* BEGER 1930 *coronopetosum squamati* OBERDORFER 1957, *Coronopo-Polygonetum avicularis* OBERDORFER 1971.

VII. Class **MOLINIO-ARRHENATHERETEA** TX. 1937 em. 1970

A. Order PLANTAGINETALIA MAJORIS TX. et PREISING 1950 em. TX. 1970

1. Alliance ***Lolio-Plantaginion majoris*** SISSINGH 1969

Suballiance *Lolio-Plantaginenion* ELIÁŠ hoc loco

Association:

1. **Lolio-Plantaginetum majoris** BEGER 1930

Suballiance *Plantagini-Prunellenion* ELIÁŠ 1980

Association:

1. **Prunello-Plantaginetum majoris** FALINSKI 1963

Suballiance *Plantagini-Cynodontenion* ELIÁŠ hoc loco

Association:

1. **Cynodonto-Plantaginetum majoris** (GAMS 1927) BRUN–HOOL 1962

Syn.: *Polygonetum avicularis* GAMS 1927 p. p., *Cynodon dactylon*-Ass. FELFÖLDY 1942 p. p., *Cynodono-Plantaginetum* GAMS 1927 non orig. sed. sec. KRIPPELOVÁ 1972, non *Cynodontetum* GAMS 1927, nec *Cynodontetum dactyloni* BOJKO 1934.

B. Order AGROSTIETALIA STOLONIFERAE OBERDORFER in OBERD. et al. 1967

1. Alliance *Agropyro-Rumicion crispi* NORDHAGEN 1940

Suballiance *Ranunculo repentis-Rumicenion crispis* HEJNÝ et KOPECKÝ in HEJNÝ et al. 1979

Associations:

1. **Rorippo sylvestris-Agrostietum stoloniferae** OBERDORFER et TH. MÜLLER in TH. MÜLLER 1961

Subassociations:

— *trifolietosum neglectae* KRIPPELOVÁ 1967
— *juncetosum articulati* KOPECKÝ in HEJNÝ et al. 1979

2. **Potentilletum anserinae** FELFÖLDY 1942

Syn.: *Potentilletum anserinae* RAPAICS 1927, *Lolio-Potentilletum anserniae* KNAPP 1946, *Potentilletum anserinae* (RAPAICS 1927) PASSARGE 1964.

Subassociations:

— *typicum* ELIÁŠ hoc loco
— *lolietosum* (PASSARGE 1964) ELIÁŠ hoc loco
(Nomenclatural type: FELFÖLDY 1942, Tab. 5, Relevé No. 2)
— *trifolietosum fragiferae* ELIÁŠ hoc loco
(Nomenclatural type : FELFÖLDY 1942, Tab. 5, Relevé No. 3)

3. **Potentilletum reptantis** ELIÁŠ 1974 em. 1978

Syn.: *Potentilletum reptantis* ELIÁŠ 1974 em. POP 1979 p. p.

4. **Prunello-Potentilletum reptantis** ELIÁŠ 1978

Syn.: *Potentilletum reptantis* ELIÁŠ 1974 em. POP 1979 p. p.

5. **Festuco arundinaceae-Althaeetum officinalis** NEUHAUSLOVÁ–NOVOTNÁ 1968

6. **Potentillo-anserinae-Festucetum arundinaceae** NORDHAGEN 1940

Suballiance *Loto-Trifolenion* WESTHOFF et VAN LEEUWEN ex VICHEREK 1973

Associations:

1. **Loto-Potentilletum anserinae** VICHEREK 1973

Subassociations:

— *typicum* VICHEREK 1973
— *taraxacetosum bessarabicum* VICHEREK 1973

2. **Blysmo-Juncetum compressi** Tx. 1950

3. **Junco inflexi-Menthetum longifoliae** LOHMEYER 1953

Suballiance *Juncenion effusi* WESTHOFF et VAN LEEUWEN ex HEJNÝ et al. 1979

1. **Epilobio-Juncetum effusi** OBERDORFER 1957

2. **Juncetum effusi** (PAUCA 1941) SOÓ 1947

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Acta Botanica Academiae Scientiarum Hungaricae, Vol. 27 (3—4), pp. 351—364 (1981)

REPRODUCTIVE ALLOCATION IN THE STAGES OF SANDY SUCCESSION*

By

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(Received: March 20, 1981)

The reproductive allocation (RA) of two perennials (*Festuca vaginata* and *Alyssum montanum* ssp. *gmelinii*) as well as two annuals (*Arenaria serpyllifolia* and *Silene conica*) was studied in the stages of sandy primary succession. The sampled individuals were separated into fertile, assimilating as well as root weight. The weight of the competitors in the community was estimated too. The relative RA value varies according to the stages of succession for each species. The factors influencing the variability of RA were determined by path analysis. For the annuals the direct effect of the assimilating mass is significant in each stage while that of the root it is secondary as is the cenological influence (the effect of the other species). For the perennials the internal influence on RA (on the fertile weight) differs for each stage. In the closed vegetation stage not only internal factors but also cenological ones have a role on the weight variability of the fertile parts of the two perennial species, moreover this external influence becomes dominant for *Festuca vaginata*.

Introduction

The resources, assimilatives within the individuals of the plants may be divided for growing, maintenance and reproduction in rather different ways. The basic types of these material allocations of physiological character are strategic-like adaptations of the plants (Harper and Odgen 1970), and their development is assured by selection in the community. A knowledge of the different kinds of allocations but mainly the reproductive allocation (RA, Cody 1966, Harper and Odgen l.c.) and the plasticity of allocation as a tactic of the plant itself is very important also for understanding the course of succession. During succession, the species saturation as well as the number of individuals falling to unit area increases, the biotic effects rise. The species of the preceding stage of the succession, which have survived in a less saturated, more abiotic environment up to the present, now have to hold out in a new environment where the nutritional uptake processes are hindered or slowed down. Moreover, beside their fixation and nutrition absorption tasks the underground parts often have to take part in the active site sustenance too. The absolute size and inner proportions of the green assimilating organs, moreover the biochemical conditions of the photosynthesis (pigment and enzymatic concentrations etc.) are influenced by the mutual shading thereby changing the amount, transport and allocation of the nutritives. All these and the mutual shading affect flower formation and the amount of the crops.

However, most of the species are generally unable to adapt to any considerable degree it is very interesting what allocation pattern the few species surviving more stages of the succession show in the process of vegetation development.

* Tece studies No. 24.

Theoretically it may happen that the allocation proportions remain unchanged all the time; if it does not (as much more can be excepted), the change is very important also because it may have an influence on the population dynamics which assure the maintenance of the species in the community. Present examinations are motivated by the connections of the cenological environment and the RA as it will be expounded in the description of the experimental setting.

Some preliminaries

Two types of energy allocation are distinguished by HARPER and OGDEN (l.c.), 1. life cycle strategy, which is related to the whole complex time and space pattern of energy allocation by the organism, 2. reproductive strategy which is related by the energy allocation particularly associated with reproduction. At the same time it can be realized that the latter is an integral part of the total life cycle strategy.

The RA is a strategy emerging at the organizational level of the individual; other strategies affecting at the population level (the r and K, MacARTHUR 1962) most likely are connected with the RA. The possibility that colonizing r-strategic species have greater reproductive effort than those living in a mature (climax) community was suggested by HARPER as early as 1967. GADGIL and SOLBRIG (1972) are also of the opinion that the reproductive effort of the r-selected genotypes is greater than that of the K-selected ones. KAWANO (1975) also believes that the RA according to energy and dry weight is much higher for annuals than for perennials. According to GADGIL and BOSSERT (1970), WILLIAMS (1966) the pattern of the material allocations has been controlled by natural selection.

In connection with the reproductive strategies we can count on having, the following problems: 1. What proportion of the biomass does the plant use for reproduction, 2. How constant is this proportion and how much is it modified by the environment, 3. How efficient is reproduction considering the biomass and energy effort, respectively. The latter question is obviously, the most important, yet it has been the least studied. This study is mainly concerned with point 1 and point 2.

Several experiments have been carried out to estimate the modifying effects of the environment. Analysing the RA of *Heloniopsis orientalis* (*Liliaceae*) in accordance with the altitudinal regions (KAWANO and MASUDA 1980) this proportion has been found to be higher in subalpine and alpine regions than in plain-hilly country. In case of a strong density-independent stress, HICKMAN found (1977) a greater RA in *Polygonum* species. It has also been shown (JAKSIĆ and MONTENEGRO 1979) that under the same experimental conditions the responses given by the annuals differ from the responses given by the perennials. With perennials the examination of the question is more difficult because of the vegetative character of RA (multiplication by various propagules: bulbs, rhizomes, stolons, etc.).

In the energy allocation differences based also genetically may arise in ecotypes, e.g. in case of *Tussilago farfara* relatively higher vegetative RA and lower seed RA were manifested in a severer climate comparing to ecotypes living in a more favourable climate (BOSTOCK 1980). In this species and others, too, fewer numbers but larger sizes of propagulums seem to be more favourable for maintenance in case of more pronounced environmental stress. It is not certain that the selection affects in the same direction in the two types of propagation. For example, it has been shown that *Cirsium arvense* is a definite r-strategist respect-

ing the vegetative reproductive strategy while its seed reproductive strategy is rather a *K*-strategy (Bostock and Benton 1979). The control of the reproductive effort should not exclusively be sought in the environment. An example of this is the *Allium* genus where the reproductive effort differs also within one species according to the various reproduction types (Kawano and Nagai 1975).

Falińska (1979) has carried out investigations well interpreted cenologically on *Caltha palustris* where the ratio of generative and vegetative RA may differ from community to community mainly due to the higher variability of generative RA.

Sandy succession and the examined species

The sampling site was on the sandy tableland near Fülöpháza lying 25 km west of Kecskemét in the Danube–Tisza Interfluve of the Great Hungarian Plain, Kiskunság National Park. It is a hilly country of uneven terrain surface, a large number of hills have already been bound by a semiclosed vegetation with the exception of some active sand dunes shifting even today.

The vegetation is an extended sandy grassland, the succession has not developed into a forest stage on account of vegetation history and ecology. Smaller clusters of *Populus alba* and its forerunner *Salicetum rosmarinifoliae* blended with *Festuca vaginata* grass can be found only in patches in depressions between dunes, near to the subsoil water. Here and there Juniper shrubs have also colonized alone or as components of *Junipereto-Populetum*.

Concerning the Danube–Tisza Interfluve, in the literature more schemes of sandy succession have been published but as these are partly too simplified and partly broad, we shall not deal with them here. From our observations it may be probable that 1. The same stage — so the last one as well — may be formed in different successional ways. 2. Beside the primary series secondary successional series can also be found, moreover, these may be connected. 3. Besides the annual grasses equivalent to each other (*Secale silvestre*, *Bromus tectorum*, *B. squarrosus*, etc.), the perennial sandy grassland is not uniform either in its composition, or in its closure: due to the variegated relief the total flora of the community has disintegrated into species multiplets, separating in space and replicated in their stands.

It should also be noted that the stages of succession have not been established with respect to time, although, there were signs of the time feature from e.g. the geomorphology of the moving sandy dunes, and the composition of the vegetation. With perennial grasses the criterion was the increasing closeness of the stands of different spatial position.

The communities and stages serving as an environment for the sampled species are: annual grass rich in mosses-lichens (species: *Arenaria serpyllifolia*, *Secale silvestre*, *Cladonia foliacea*, *Cl. furcata*, *Syntrichia ruralis*, *Tortella inclinata*); *Bromus squarrosus* grass (*Silene conica*, *Arenaria serpyllifolia*, *Alyssum*

alyssoides). Stages of *Festucetum vaginatae:* open, semi-closed, closed. (In the open grass, *Centaurea arenaria*, in the half-closed and closed. *Stipa sabulosa, S. capillata, Carex liparicarpos, Alyssum montanum* ssp. *gmelinii, Koeleria glauca, Cynodon dactylon, Euphorbia seguieriana, Scabiosa ochroleuca, Arenaria serpyllifolia, Silene conica.*)

In this study the analysis of the RA has been shown in four species. The life form of this species is different — for the sake of contrast, two are perennials and two are annuals.

The eponymous species of the perennial community is the hemicryptophyte *Festuca vaginata*. It may be present in each link of the sandy succession, already in the pioneer stage, as a colonizing species; at the same it can bear the total closeness of the grassland (the conspecific influences). Beside generative multiplication it multiplies also in a vegetative way (by intravaginal shoots, limited spread).

Alyssum montanum ssp. *gmelinii* (further on *Alyssum gmelinii*) is missing from the primary pioneer phases but may be present in the annual grass of the secondary succession. The dwarf shrub (chamaephyte) multiplies only from seed.

The two annual species, namely *Arenaria serpyllifolia* and *Silene conica* are found mainly in annual grasses. In perennial sandy grassland *Silene conica* occurs only rarely — even if there are considerable gaps in the *Festuca vaginata* tufts — probably as a consequence of disturbances. *Silene* is an annual of early summer, germinating in autumn multiplies only by seed. *Arenaria serpyllifolia* sprouts in autumn, flowering quickly in spring and ripening crops, after ripening it does not die but lives till the middle of summer developing fresh shoots. It multiplies only by seed, one plant may produce more than 10,000 seeds (UJVÁROSI 1973).

Methods

Only fertile material in a stage near ripening has been collected. The plants were collected from sample areas of various sizes, the size of the sample area was determined after estimating the influence area of the sampled plant and the other species (considering rhizosphere volume, mutual shading and other interferences).

In open *Festuca vaginata* grass the size of the plant *Festuca vaginata* justified having a circular sampling area of 200 cm in diameter, while in a half-closed or closed stand the same plant has a considerably smaller size hence only a circular sampling area of 100 cm in diameter was needed.

When sampling *Alyssum gmelinii* a circular sampling area of 50 cm in diameter was considered to be optimal. Plants having 30 pces $\pm$ 5 pces of ligneous stems were collected.

When sampling *Arenaria serpyllifolia* and *Silene conica*, respectively, the circular sampling areas were of 10 cm and 20 cm, respectively, in diameter.

To measure the influence of the other species within the sampling circle the estimate of the mass representation of species was performed either on the basis of the number of pieces (e.g. *Secale silvestre, Bromus squarrosus*) or on the basis of the coverage (e.g. *Festuca vaginata, Alyssum gmelinii*). When examining the RA of *Festuca vaginata* the influence of the

conspecific competitor was estimated on the basis of the biomass values (stadia II and III). In case of other competitors („minor species") we estimated the total number of pieces and the total coverage, respectively, disregarding the taxonomical qualification of the species.

After clearing and removal of the foreign materials, the samples drawn by a required reiteration were fractionized, and the fertile part, assimilation organs and root mass were separated in each species.

In *Festuca vaginata*, by fertile part is meant the spica together with the inflorescence axis (the latter is the inflorescence above the node), and the assimilation part means the part of the plant excluding the fertile part and root. The fertile part of *Alyssum gmelinii* is the raceme, and its assimilation part is the ligneous stem together with the leaves.

The fertile part of *Arenaria serpyllifolia* is the capsule with seeds in it, and its assimilating part is the remaining above soil part of plant. Fractionizing of *Silene conica* is performed similarly to that of *Arenaria serpyllifolia*.

The fractionized parts of the plant were exsiccated at a temperature of 110 °C and weighed. Although, not only the fertile weights according to species but also the weight of the direct multiplying organs (seeds), number of seeds and with this also the weight of one seed is at our disposal — which are important parameters of reproductive strategy in this study we operate only with the total fertile weight, and the RA also relates to this.

Results

The relative values of the reproductive allocation and the successional stages.

It can be seen in Table 1 that the RA proportions of the two annual species are higher than that of the two perennial ones. At the same time, the responses of the annulas to the biotic influences of the more closed, perennial grasses differ: the relative RA of *Silene* increases while that of *Arenaria* decreases. The two perennials decrease the RA proportion by closure (in

Table 1

Averages of the relative RA data according to the successional stadia and levels of significance of their differences of the species examined (Result of ANOVA)
* P ≤ 5%, ** P ≤ 1%, *** P ≤ 0.1%

Festuca vaginata

Successional stadium	I	II	III
I	0.175		
II	**	0.267	
III	**	***	0.071

Alyssum gmelinii

Successional stadium	I	II
I	0.232	
II	***	0.171

Arenaria serpyllifolia

Successional stadium	I	II	III
I	0.288		
II	*	0.346	
III	NS	***	0.254

Silene conica

Successional stadium	I	II
I	0.293	
II	***	0.383

Table 2

Average dry weight (g/plant) values of Festuca vaginata according to the successional stages (I: open annual, II: semiclosed perennial, III: closed perennial sward)

	Fertile weight	Total weight
I	18.05	111.60
II	3.18	12.61
III	0.39	6.59

case of *Festuca* by total closure). As is shown in the table the relative values of RA sensitively indicate the change in the cenological environment. Only *Arenaria* shows similar values in stages I and III otherwise the cenological "handling" provokes reliable different allocation-reactions.

Although, we are convinced that the plant responses considering also the allocation can be measured adequately by the relative values and proportions (as well as the biochemical response reactions by concentration-proportions), the development of the absolute values is not negligible either. In *Festuca vaginata* (Table 2) 1. there was a difference of quite an order 2. and this difference was not shown in such an extent in the relative values just because of the correlation between the fertile weight and total weight. 3. The tendency is that the biomass decreases by the closure and besides, previously, — already in the semi-closed sward — the total biomass is more sensitive, on the other hand, the plant responds to the total closure by a drastic decrease of fertility. Here the self-maintenance of the vegetative body seems to be the main task of the material allocation where the success of sexual reproduction is rather limited anyway.

The internal and external influences on RA

The correlations between the variables enable the examination of individual and cenological background of the RA (of the allocation within individual for reproduction, assimilation parts, fixation, as well as of the interaction of the preceding ones with each other and the external influences of the other individuals on them). The correlation matrices provided the data for path analyses (Li 1955, Le Roy 1960, O'svÁth 1967, Sváb 1973). Each of the path schemes reflects the connection of the individual and cenological levels and the conception that each fraction of the material allocation within an individual may depend on the cenological level (density dependence s. l.).

On preliminary considerations we used four kinds of cognate schemes (Fig. 1), these versions differ only in cenological level, partly in number of components, partly in that a correlation (supposedly the species are equivalent considering their effect e.g. annual-annual, perennial-perennial) or an undirectional influence (perennial-annual) may be counted.

Festuca vaginata

On the moving dune-top (I, pioneer stage) the direct influence of the green assimilating mass on RA variability is considerable. Furthermore all the other direct influences are insignificant. In semi-closed sward the role of the two internal components is interchanged, and here the influence of the root weight becomes decisive. In a closed sward then, both internal allocation influences within the individual fall into the background, and the control function is taken over by the cenological influences (Table 4).
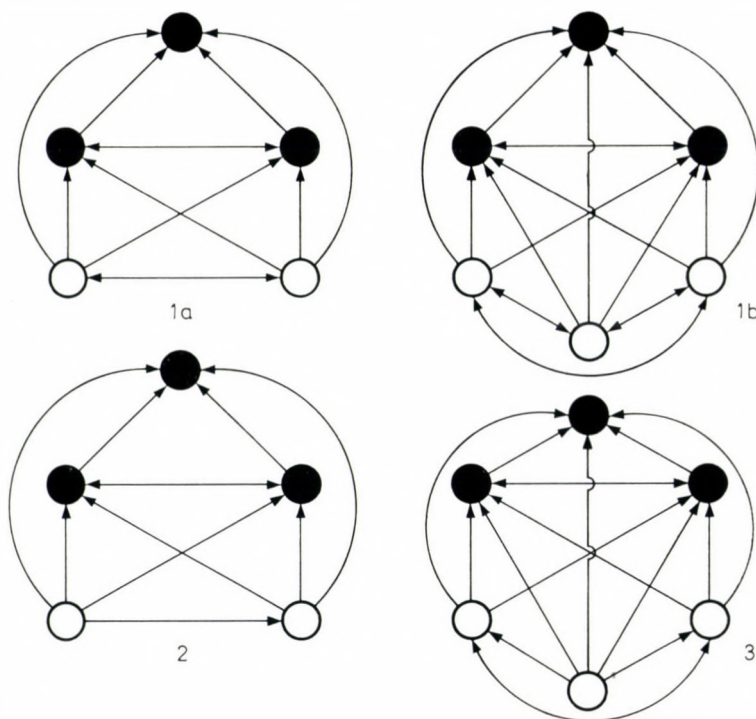
Fig. 1. The four types of path schemes applied. *1a: Alyssum gmelinii* in II. stadium, *Silene conica* in I., II. stadia, *Festuca vaginata* in I. *1b: Arenaria serpyllifolia* in I. and II. stadia, *Festuca vaginata* in II. and III. stadia. *2: Alyssum gmelinii* in I. *3: Arenaria serpyllifolia* in III. stadium. — Filled circles: variables of the individual level (on the top: reproductive weight, the lower two: weight of assimilation organs, root weight). Empty circles: variables on the supraindividual (cenological) level

Table 3

Coefficients of correlation between allocation variables of Festuca vaginata and cenological variables in the three successional stadia

(I: open annual, II: semi-closed perennial, III: closed perennial sward)
Explanation: I: 1 — reproductive weight, 2 — weight of assimilation organs, 3 — weight of roots, 4—6 — weight of competitors so: 4: biomass of *Festuca vaginata* individuals, 5: biomass of *Centaurea arenaria* individuals. — II: 1—4 — as before, 5 — biomass of *Euphorbia seguieriana* individuals, 6 — biomass of other species. — III: 1—6 — as before

I

	1	2	3	4
2	.899			
3	.747	.886		
4	.421	.281	—.024	
5	—.216	—.152	—.207	.051

II

	1	2	3	4	5
2	.283				
3	.696	.699			
4	.577	.446	.631		
5	—.265	—.190	—.141	.287	
6	.391	.222	.139	.219	—.208

III

	1	2	3	4	5
2	.500				
3	.388	.742			
4	.715	.754	.624		
5	—.197	.176	.413	.506	
6	—.022	—.222	—.213	—.162	—.375

The correlation coefficients given in Table 3 also show the loosening connection of the weight of assimilation organs and root weight with the weight of fertile part; with their breakdown it could be seen that where the direct influence of the assimilating mass was considerable, the root weight exerted its influence — which was not insignificant — in an indirect way.

The conspecific influence (the other *Festuca vaginata* individuals, intraspecific competition) is an important cenological factor for the reproductive allocation of *Festuca vaginata*, and in Table 5 it is illustrated in details. In pioneer stage and also in a semi-closed sward the common influences are still important and surpass the insignificant direct influence of *Festuca vaginata* population. The cenological, direct influence is already felt in a closed sward. In semi-closed and closed sward not only the fertile parts but also the weight of assimilation organs and root weight are under cenological control. This is also shown by the high values of the correlation coefficient according to the breaking down of which — not published here — not the direct but the indirect paths are the more important.

Table 4

Direct effects on reproductive weight of Festuca vaginata and breaking down of multiple determination coefficient (R^2) in the three successional stadia. Explanation of indices see Table 3

I effect	I relative	I %	II effect	II relative	II %	III effect	III relative	III %
$p_{21} = 1.1037$	$p_{21}^2 = 1.2182$	121.82	$p_{21} = -0.3993$	$p_{21}^2 = 0.1594$	15.94	$p_{21} = 0.4771$	$p_{21}^2 = 0.2219$	22.19
$p_{31} = -0.2311$	$p_{31}^2 = 0.0534$	5.34	$p_{31} = 0.9757$	$p_{31}^2 = 0.9520$	95.20	$p_{31} = 0.0387$	$p_{31}^2 = 0.0015$	0.15
$p_{41} = 0.1103$	$p_{41}^2 = 0.0122$	1.22	$p_{41} = 0.1319$	$p_{41}^2 = 0.0174$	1.74	$p_{41} = 0.6527$	$p_{41}^2 = 0.4260$	42.60
$p_{51} = -0.1016$	$p_{51}^2 = 0.0103$	1.03	$p_{51} = -0.1839$	$p_{51}^2 = 0.0338$	3.38	$p_{51} = -0.6392$	$p_{51}^2 = 0.4086$	40.86
			$p_{61} = 0.2765$	$p_{61}^2 = 0.0765$	7.65	$p_{61} = -0.0433$	$p_{61}^2 = 0.0019$	0.19
common ($2p_ip_jr_{ij}$)	-0.4680	-46.80	common ($2p_ip_jr_{ij}$)	-0.3574	-35.74	common ($2p_ip_jr_{ij}$)	-0.0284	-2.84
total,	$R^2 = 0.8261$	82.61	total,	$R^2 = 0.8817$	88.17	total,	$R^2 = 1.0315$	103.15
$p_e = 0.4170$	$p_e^2 = 0.1739$	17.39	$p_e = 0.3439$	$p_e^2 = 0.1183$	11.83			

Table 5

Breaking down of the coefficient of correlation r_{14}
(*Festuca vaginata*, 3 successional stadia)
Explanation of stadia and indices see Table 3

I effect	I value	II effect	II value	III effect	III value
direct (p_{41})	0.1103	direct (p_{41})	0.1319	direct (p_{41})	0.6527
indirect, via *Centaurea* ($r_{45}\ p_{51}$)	-0.0052	indirect, via *Euphorbia* ($r_{45}\ p_{51}$)	-0.0527	indirect, via *Euphorbia* ($r_{45}\ p_{51}$)	-0.3236
		indirect, via other species ($r_{46}\ p_{61}$)	0.0605	indirect, via other species ($r_{46}\ p_{61}$)	0.0070
common	0.3162	common	0.4375	common	0.3793
total (r_{14})	0.4212	total (r_{14})	0.5772	total (r_{14})	0.7154

Alyssum gmelinii

In the two stages the response reaction differs and the reason for this must be sought mainly in the change of the effect of the root mass. This can be seen in Table 6, too.

Table 6

Direct effects on the reproductive weight of Alyssum gmelinii and breaking down of the multiple determination coefficient (R^2) in the two stadia
(I: annual, II: perennial sward)
Explanation of indices: I: 4 — cover of *Alyssum gmelinii* individuals, 6 — cover of other species. II: 5 — cover of perennial *Gramineae* species, 6 — cover of other species. — 1, 2 and 3 as before (Table 3)

I					II				
		effect	relative	%			effect	relative	%
p_{21} =	0.5736	p_{21}^2 =	0.3290	32.90	p_{21} =	0.7604	p_{21}^2 =	0.5782	57.82
p_{31} =	0.4261	p_{31}^2 =	0.1816	18.16	p_{31} =	−0.2788	p_{31}^2	0.0777	7.77
p_{41} =	−0.0760	p_{41}^2 =	0.0058	0.58	p_{51} =	0.4629	p_{51}^2 =	0.2143	21.43
p_{61} =	−0.1789	p_{61}^2 =	0.0320	3.20	p_{61} =	0.0755	p_{61}^2 =	0.0057	0.57
		common ($2p_ip_jr_{ij}$) =	0.1763	17.63			common ($2p_ip_jr_{ij}$) =	−0.0719	−7.19
		total R^2 =	0.7247	72.47			total R^2 =	0.8040	80.40
p_e =	0.5247	p_e^2 =	0.2753	27.53	p_e =	0.4427	p_e^2 =	0.1960	19.60

The positive influence of the assimilation parts is even stronger in the perennial sward than in the annual one while the root weight has an influence in the negative direction. At the same time the perennial *Gramineae*-species of the perennial sward also assumes control function and this is stronger than that of the root weight at the individual level. The connection between the RA and the perennial grasses mainly comprises the mentioned direct influence, the indirect and common influences largely spoil each other. In the annual sward the cenological direct influence is insignificant. (Table 6). Compared with the annual sward, the absolute value of the error path decreases in the perennial sward, and its influence is smaller compared with the other influences.

The two annual species

In *Arenaria serpyllifolia* according to the 3 stages with the increasing density of vegetation, the determination of RA increases, which can be measured by the increasing values of R^2. Although, this rise can mainly be attributed to the increasing role of the cenological component, but this influence is subtle because it affects through indirect-common paths (through

Table 7

Breaking down of the coefficient of correlation r_{12} and r_{13}
(*Alyssum gmelinii*, two successional stadia, I: annual, II: perennial sward).
Indices: 2: weight of assimilation organs, 3: root weight

I				II			
effect	value	effect	value	effect	value	effect	value
direct (p_{21})	0.5735	direct (p_{31})	0.4261	direct (p_{21})	0.7604	direct (p_{31})	−0.2788
indirect via root weight ($r_{23}p_{31}$)	0.1206	indirect via assimilation organs ($r_{23}p_{21}$)	0.1624	indirect via root weight ($r_{23}p_{31}$)	−0.0979	indirect via assimilation organs ($r_{23}p_{21}$)	0.2670
total (r_{12})	0.6942	total (r_{13})	0.5885	total (r_{12})	0.6625	total (r_{13})	−0.0118

Table 8

Direct effects on the reproductive weight of Arenaria serpyllifolia and breaking down of the multiple determination coefficient (R^2) in the three stadia I: annual sward rich in mosses-lichens, II: *Bromus squarrosus* sward, III: perennial sward). Explanation of indices: I: 4: number of individuals of *Arenaria serpyllifolia*, 6: number of individuals of other species, II: 4: number of individuals of *Arenaria serpyllifolia*, 5: number of individuals of *Bromus squarrosus*, 6: individual number of other species, III: 4: individual number of *Arenaria serpyllifolia*, 5: diameter of *Festuca vaginata* tufts, 6: individual number of other species. — 1, 2 and 3 as before (Table 3)

I			II			III		
	effect relative	%		effect relative	%		effect relative	%
$p_{21} = 0.7766$	$p_{21}^2 = 0.6031$	60.31	$p_{21} = 0.6057$	$p_{21}^2 = 0.3669$	36.69	$p_{21} = 0.6889$	$p_{21}^2 = 0.4746$	47.46
$p_{31} = 0.0267$	$p_{31}^2 = 0.0007$	0.07	$p_{31} = 0.2597$	$p_{31}^2 = 0.0674$	6.74	$p_{31} = 0.2871$	$p_{31}^2 = 0.0824$	8.24
$p_{41} = 0.1751$	$p_{41}^2 = 0.0307$	3.07	$p_{41} = -0.0007$	$p_{41}^2 = 0.0000$	0.00	$p_{41} = -0.1331$	$p_{41}^2 = 0.0177$	1.77
$p_{61} = 0.0023$	$p_{61}^2 = 0.0000$	0.00	$p_{51} = -0.2211$	$p_{51}^2 = 0.0489$	4.89	$p_{51} = 0.0403$	$p_{51}^2 = 0.0016$	0.16
			$p_{61} = -0.4631$	$p_{61}^2 = 0.2145$	21.45	$p_{61} = -0.0302$	$p_{61}^2 = 0.0009$	0.09
common ($2p_ip_jr_{ij}$)	$= -0.1057$	−10.57	common ($2p_ip_jr_{ij}$)	$= 0.0694$	6.94	common ($2p_ip_jr_{ij}$)	$= 0.2445$	24.45
total R^2	$= 0.5288$	52.88	total R^2	$= 0.7671$	76.71	total R^2	$= 0.8217$	82.17
$p_e = 0.6864$	$p_e^2 = 0.4712$	47.12	$p_e = 0.4826$	$p_e^2 = 0.2329$	23.29	$p_e = 0.4223$	$p_e^2 = 0.1783$	17.83

Table 9

Direct effects on the reproductive weight of Silene conica and breaking down of the multiple determination coefficient (R^2) in the two stadia
(I: annual *Bromus squarrosus* sward, II: perennial sward)
Explanation of indices: I. 5: number of individuals of *Bromus squarrosus*, 6: number of individuals of other species, II. 5: cover of *Festuca vaginata*, 6: cover of other species. — 1, 2 and 3 as before (Table 3)

I					II				
effect		relative		%	effect		relative		%
p_{21} =	1.0199	p_{21}^2 =	1.0402	104.02	p_{21} =	0.7672	p_{21}^2 =	0.5886	58.86
p_{31} =	−0.4131	p_{31}^2 =	0.1707	17.07	p_{31} =	0.1540	p_{31}^2 =	0.0237	2.37
p_{51} =	0.1358	p_{51}^2 =	0.0184	1.84	p_{51} =	−0.1341	p_{51}^2 =	0.0180	1.80
p_{61} =	0.0200	p_{61}^2 =	0.0004	0.04	p_{61} =	−0.0425	p_{61}^2 =	0.0018	0.18
		common ($2p_ip_jr_{ij}$) =	−0.7174	−71.74			common ($2p_ip_jr_{ij}$) =	0.2143	21.43
		total R^2 =	0.5123	51.23			total R^2 =	0.8464	84.64
p_e =	0.6984	p_e^2 =	0.4877	48.77	p_e =	0.3913	p_e^2 =	0.1536	15.36

the "common" influences). The direct influence of the cenological component is insignificant in all the three stages. The allocation proportions, moreover the rate of direct influence of weight of assimilation organs and root weight are fairly similar in the three stages. The breakdown of r_{12} and r_{13} (not published in details) shows in all the three stages that the weight of assimilation organs (2) directly, and the root weight (3) indirectly influence RA (1).

In *Silene conica* the influence of the growing density is manifest by the increasing determination coefficient. Again, not the determination according to the individual level but according to the cenological level rises. Similar to *Arenaria*, here also, the indirect-common paths are more significant while the direct cenological effect is insignificant.

However, in the *Silene* allocation relations it can be seen that there is a shift according to the two stages and for example, the negative effect of the root weight becomes positive in the perennial sward. A property of *Silene* which seems to be consistent — irrespective of the community — is that the influence of the weight of assimilation organs — similarly to *Arenaria* — is direct, while the root weight affects only in an indirect way through the weight of assimilation organs.

Discussion

With the annuals the influence of the root weight has a subordinate role while the part of the weight of assimilation organs is more clear-cut, compared to the perennials. This is in a good harmony with considerations

that 1. the root of the perennial species has a more important function in the competition process than that of the annuals, 2. the strategy of the annuals (reproductive but also other non-reproductive strategies) is connected with the rapid development, quick pace of material allocation, and great adaptive readiness, and all these presuppose a great plasticity of the assimilation organs.

With a significant change of the RA relative values according to the successional stages the two examined perennials show the same plastic pattern of allocation as the annuals. So the opinion emphasising a high degree of constancy of the sexual reproduction of the perennials in spite of the changeability of environment (Raynal 1979, Bradbury and Hofstra 1976, Holler and Abrahamson 1977, Abrahamson and Hershey 1977) cannot be confirmed. On the contrary, it is remarkable in the case of the two perennials that the internal influence on RA differs from stage to stage. In *Festuca vaginata* and *Alyssum gmelinii* this response reaction seems to be intensified and only nutrition physiological examinations may give an answer to it.

It may be considered an important result that in the two perennial species in closed stages the direct cenological influence, also affects the control of the weight of the fertile part. It seems to be a contradiction, however, that this influence is positive in both species because the tendency generally is just the decrease of the relative RA at an increasing density. So for example, the increase of the biomass of *Festuca vaginata* individuals as competitors in closed stages implies the increase of the weight of fertile part of *Festuca vaginata* sample plant. But it must be taken into consideration that the results of the path analysis relate not to the relative RA but to the absolute weights of the plant parts.

As to the method, the path analysis seems to be an adequate means also for the description of these kinds of causal systems. It can also be stated that the variability of the dependent variable (the reproductive weight) is described fairly well by the internal and external factors drawn into the examination.

It is desirable that the further examinations should stress the population dynamical aspects of RA. Here questions arise for example, whether the succession, closure, intra- and interspecific competition influence on the dynamics of populations through the modification of RA only and so through the natality component or perhaps in other ways, too (e.g. through influence on survivorship, mortality).

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Acta Botanica Academiae Scientiarum Hungaricae, Vol. 27 (3–4), pp. 365–368 (1981)

CHLOROMIRUS, A NEW GREEN ALGA GENUS FROM THE DANUBE

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(Received: 1 March 1981)

Author published a green alga belonging to *Chlorococcales*, under the name *Nephrocytium* sp. in 1973. The rare organism in 1974 was abundantly recollected and it proved to be a new genus nominated and described here as *Chloromirus* HORTOBÁGYI gen. nov. The *Hydrocystis hydrophyla* TURNER is also classified into this genus under the name: *Chloromirus hydrophylus* (TURNER) HORTOB. comb. nov.

Introduction

In my work entitled "The Microflora in the Settling and Subsoil Water Enriching Basins of the Budapest Waterworks" (HORTOBÁGYI 1973) I published an alga belonging to *Chlorococcales* under the name of ? *Nephrocytium* sp. (l.c. p. 75, Fig. 606) from the collectings made on the 22th of August and 15th of September, 1969 in the water settling basin of the Budapest Waterworks filled by Danube water. This species came seldom into my view, therefore I could not yet thoroughly observe its way of propagation.

During my studies on the collectings made from the river Danube (14th of May, 1974, at stream-kilometres 1608, 1618, 1623, 1628) I could detect them abundantly as well as in the water samples taken on the 23rd of May (at stream-kilometres 1608, 1623, 1628, 1633, 1643). Their coenobia have shown greater variability, than those of the earlier gatherings and I came across reproducing cells too.

Chloromirus HORTOB. n. gen.

The cells are elongate, straight or bent, with rounded ends. They are embedded in colourless slime and are loosely connected with each other by jelly strings. The number of cells in the coenobia is rarely more, than 10. Chloroplast occurs one per cell, each with a pyrenoid. The reproduction happens by autospores.

Chloromirus Pauli HORTOB. n. sp.

Plate I, Figs 1–5

The cells are straight or more or less bent or slightly contorted, spindle or crescent shaped. Their ends are tapering into rounded apex. They are embedded in a colourless slime capsule quite far from each other and are
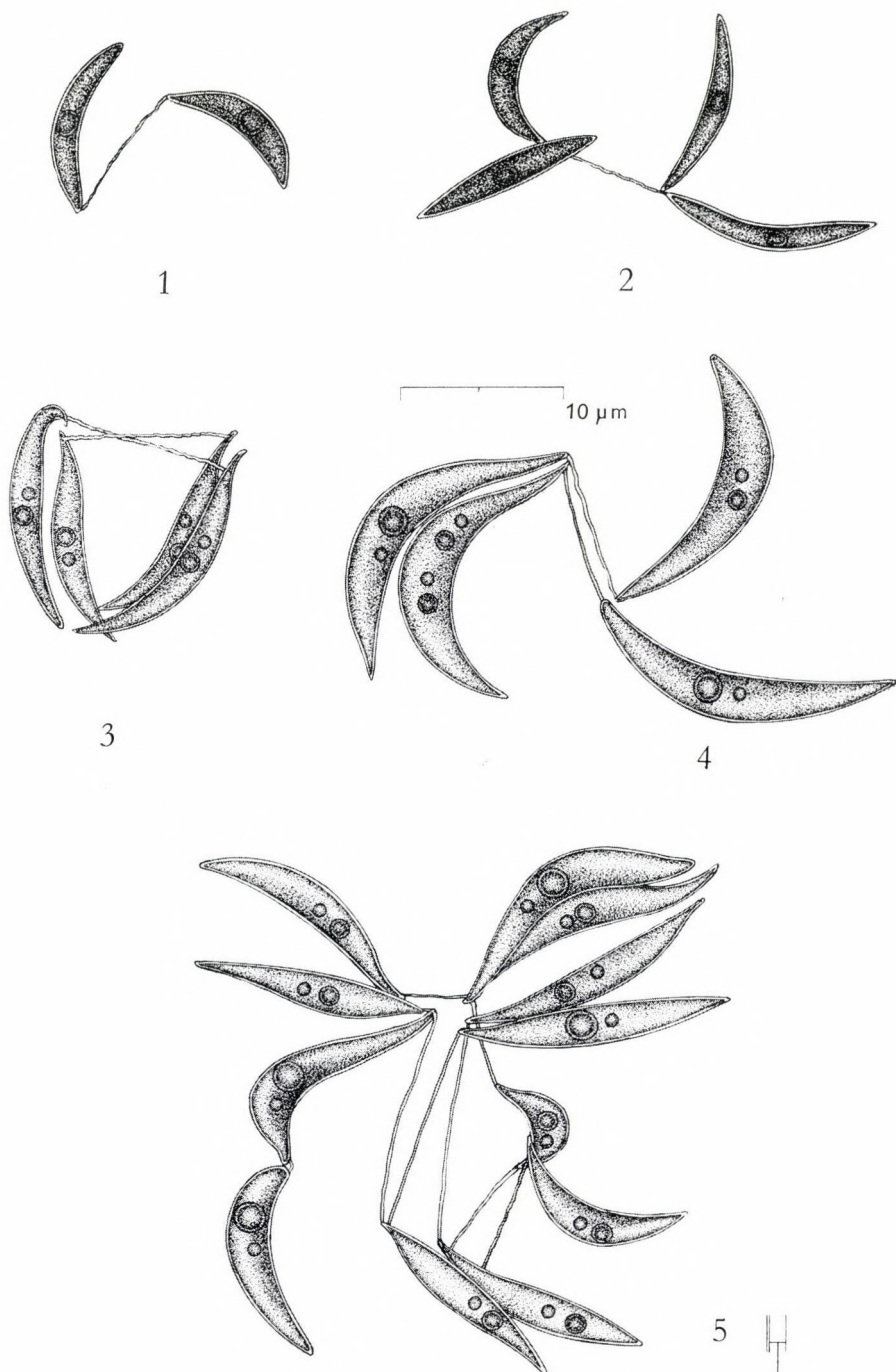
Plate I (Figs 1–5)

connected by slightly undulated, firm jelly strings, which originate from the cell poles. The length of these never threadlikely thin strings can reach as much as 20 μm. The parietal chloroplasts, each filling one cell lumen, bear one well developed pyrenoid, along the smaller nucleus. The number of cells in each coenobium varies between 2 and 12. In larger colonies the cells form tetrad groups. The size of cells is 9–12 × 1.3–3.2 μm. The way of propagation is autospore formation — V–IX. The new genus shows the closest affinity to *Nephrocytium*, but well differs by its cells connected to each other by the firm jelly strings. These jelly strings are unmistakable for the mother cell wall remnants of some *Chlorococcales* genera, e.g. for those in the coenobia of *Ankistrodesmus mucosus* KORACK, *Crucigenia Lauterbornei* SCHMIDLE, *Hofmania appendiculata* CHOD.

It seems to me on the base of pictures given by TURNER (1892, Tab. 20, Fig. 27), that his *Nephrocytium hydrophilum* (TURNER) WILLE = *Hydrocystis hydrophila* TURNER belongs also to the new genus, due to its bent, kidney shaped, elongate cells with rounded apex, which are connected to each other by thin jelly strings. Their cells are larger than those of *Chloromirus pauli* (28–57 × 20–25 μm) and their shape is also different. According to these evidences its valid name is *Chloromirus hydrophylus* (TURNER) HORTOB. comb. n.

Chloromirus HORTOB. **n. gen.**

Coenobia e cellulis plerumque usque 10, raro pluribus constructa. Cellulae elongatae, rectae vel inclinatae, laxe dispositae, funibus gelatinae inter se connectae, in chloroplaetide unico pyrenoida unica instructae. Multiplicatio per autosporas.

Chloromirus Pauli HORTOB. **n. sp.***

(Plate I, Figs 1–5)

Cellulae 9–19 × 1,3–3,2 μm, rectae vel plus-minus inclinatae vel parum tortae, fusoideae vel corniculiformes vel semilunares, versus apicem gradatim tenuiescentes, apice obtusae, muco hyalino circumdatae, inter se funibus gelatinae crassis, conspicuis, rectis vel parum undulatis, e polibus exeuntibus, nunquam tenuiter filiformibus, usque ad 20 μm longis connectae, chloroplastide parietali unico, lumen cellulae implenti, pyrenoidam singularem, bene evolutam et nucleum minorem habenti instructae. Coenobia e cellulis 2–12, plerumque quaternis constructa. Multiplicatio per autosporas. Species generis Nephrocytium eae proximae, sed species nostra ab illis cellulis funibus crassis cennoctis distincta.

Iconotypus: figura nostra 5.

* In memoriam Dr-is Pauli Hortobágyi.

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Acta Botanica Academiae Scientiarum Hungaricae, Vol. 27 (3–4), pp. 369–382 (1981)

OBERIRDISCHE NETTOPRODUKTION DER STRAUCHSCHICHT DES EICHEN-ZERREICHENWALDES VON SÍKFŐKÚT (NORDUNGARN)*

Von

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(Eingegangen: 20. Januar 1981)

Die Abhandlung umfaßt die Ergebnisse bezüglich der Jahresproduktion an organischem Material des Eichen-Zerreichenwaldes (*Quercetum petraeae-cerris*) benannt »Síkfőkút Project«.

Wir untersuchten die pro Hektar aus mehr als 93 000 Individuen bestehenden Strauchschicht in zwei Unterschichten geteilt. In der hohen Strauchschicht wurde die oberirdische Nettoproduktion von 6-, in der niedrigen Strauchschicht dagegen von 10 dominanten und häufig vorkommenden Arten gemessen, bzw. geschätzt, undzwar mit der »durchschnittlichen Strauch«-Methode und in verschiedenen Fraktionen (Laub, einjähriger Sproß, Ast + Stamm, Frucht, Blüte). Unsere Ergebnisse beziehen sich im Falle des Laubes auf die Jahre 1973, 1978, 1979, im Falle der übrigen Fraktionen dagegen auf die in den Jahren 1977–1979 gemessenen Daten.

Die jährliche oberirdische Nettoproduktion der Sträucher betrug in Trockensubstanz 1347,30 kg ha^{-1}. Davon entsteht 172,24 kg (12,75%) in den niedrigen Sträuchern und 1175,06 kg (87,25%) in den hohen Sträuchern. Den größten Teil der Strauchproduktion bildet die Laubproduktion (44,57% = 600,17 kg ha^{-1}). Einen annähernden Wert beträgt die Produktion von einjährigen Sprossen (25,33% = 341,73 kg ha^{-1}) und die von Ästen und Stämmen (29,88% = 402,42 kg ha^{-1}). Die durchschnittliche Tagesgesamtproduktion der Sträucher macht 0,64 g m^{-2} aus.

71,47% des organischen Materials wird in den zwei dominanten Arten der hohen Strauchschicht — *Cornus mas* und *Acer campestre* — gebildet.

Einführung

Die 1974 beendeten IBP-Forschungen ergründeten die globale Biomasse und Produktion der Erde (z. B. RODIN–BAZILEVICS 1967, 1968; LIETH 1964–1965, 1972, 1975; WESTLAKE 1963; OVINGTON 1965; KLÖTZLI 1968; BRAY 1963). Die sich auf die einzelnen Länder beziehenden Ermessungen fehlen jedoch momentan, oder werden gerade jetzt durchgeführt (z.B. SIMONOVICS 1973, 1978; HYTTEBORN 1975; PAPP 1979; SIMON–LÁNG 1972; K. LÁNG 1974; PRÉCSÉNYI 1969, 1969a, 1971, 1975; MÁTHÉ–PRÉCSÉNYI 1970, usw.).

Die sich an das MAB-Programm anschließenden ungarischen komplexen ökologischen Forschungen auf der Probefläche »Síkfőkút Project« wurden unter der Leitung der L. Kossuth Universität in 1972 begonnen (JAKUCS 1973, 1978). Die Untersuchung der Jahresproduktion an organischem Material bildet einen wichtigen Teil dieser Forschungen.

Der Síkfőküter-Wald ist ein ung. 70–75 Jahre alter, klimazonaler und homogener Eichen-Zerreichen-Bestand, in dem in den letzten 20–25 Jahren kein Waldbau stattfand.

* »Síkfőkút Project« No. 69.

Solche oder annähernd solche Wälder bedecken beinahe die Hälfte der hügeligen und niedrigeren montanen Gebiete unserer Heimat.

Die Strauchschicht des Waldes ist artenreich. Auf dem angemerkten Teil der Probefläche sind 16 Arten zu finden. Die Individuenzahl der Sträucher ist in den einzelnen Hektaren höher als 93 000. Davon leben in der niedrigen Strauchschicht (niedriger als 1 m und mit einem Stammdurchmesser kleiner als 1,2 cm) 87 404 Stücke, d. h. 93,5% sämtlicher Sträucher. Die am häufigsten vorkommenden Arten der niedrigen Strauchschicht sind: *Ligustrum vulgare, Euonymus verrucosus, Cornus sanguinea, Quercus petraea, Euonymus europaeus, Acer tataricum, A. campestre, Crataegus monogyna, Cornus mas, Rosa canina.* Die Individuenzahl der auf der Fläche befindlichen weiteren 6 Arten macht nur 3,32% aus. Bedeutendere Arten der hohen Strauchschicht sind: *Cornus mas, Acer campestre, Cornus sanguinea, Acer tataricum, Quercus petraea* und *Ligustrum vulgare.*

Die zönologische Zusammensetzung des Waldes entspricht im wesentlichen den nordungarischen Eichen-Zerreichenwäldern (Jakucs 1967, Papp–Jakucs 1976).

Methode

Es gibt mehrere Methoden für die Untersuchung der Jahresnettoproduktion der Sträucher (Gimingham–Miller 1968; Hytteborn 1975; Newbould 1970; Ovington–Heitkamp–Lawrence 1963; Whittaker 1961, 1962, 1965; Whittaker–Woodwell 1968). Diese Methoden bilden eigentlich eine Übertragung der Astuntersuchungsanalyse der Bäume auf Sträucher. In der Analyse der Strauchschicht des Síkfőkuter Waldes haben wir die »durchschnittliche Strauch«-Methode angewandt (Kárász 1979; Kárász–Szabó 1980). Bei der Ermessung der Struktur wurden bei sämtlichen Arten — aufgrund des Stammdurchmessers, der Höhe und Deckung — die Gössendaten der durchschnittliche Ausmaße zeigenden Sträucher bestimmt (Kárász 1976). Im weiteren wurden zur Messung der Phytomasse und Produktion der Sträucher je nach Arten 10 solche Größen aufweisenden Musterindividuen gewählt und aus den an ihnen gemessenen Daten auf die Bildung des organischen Materials je nach Hektaren gefolgert.

Die Ermessung der Produktionsfraktionen erfolgte folgendermaßen:

1. Laub

a) In 1975 (Nagy–Marosvölgyi 1977) und 1976–1977 (B. Kálóczi–Timár 1978) wurden an 8 vorherrschenden Straucharten kontinuierliche Blattwachstumsanalysen vorgenommen. Diese 8 Arten machen 98,6% der Strauchproduktion aus (*Acer campestre, A. tataricum, Cornus mas, C. sanguinea, Crataegus monogyna, Euonymus verrucosus, Ligustrum vulgare, Quercus petraea*). Es wurden jährlich vom Juni bis September teilweise unversehrte, teilweise dagegen in verschiedenem Masse durch Fraß beschädigte Blattproben gesammelt. Aus den durchschnittlichen Gewichten der Proben wurden die jährlich meßbaren durchschnittlichen Blattgewichte berechnet. Das Maß der Schädigung der Blätter durch Fraß wurde bestimmt und die von den Phytophagen konsumierte Laubmenge berechnet. Das meßbare Durchschnittsgewicht und die Summe des durch Phytophagen verzehrten Laubgewichtes macht die tatsächlich produzierte Laubproduktion aus. Bei den übrigen Straucharten wurde keine Fraßkorrektion durchgeführt, die Laubphytomaßenwerte des Jahres 1973 wurden als Laubproduktion betrachtet.

b) In 1973, bzw. 1978–1979 wurde die Laubproduktion der Sträucher bei 6 Arten der hohen Strauchschicht und bei 10 Arten der niedrigen Strauchschicht abgeschätzt. Wir haben die gesamte Laubproduktion von je 10 Sträuchern der einzelnen Arten in den ersten Septembertagen gesammelt, bis Gewichtskonstanz getrocknet, sodann gemessen. Hier wurde das Maß des Raupenfraßes an den Blättern nicht gemessen, wir benutzten aber durchschnittliche Fraßprozentwerte aus den im vorigen Abschnitt beschriebenen Untersuchungsergebnissen, extra für jede Art. Aufgrund dieser Prozentwerte wurde berechnet wieviel Laub durchschnittlich von den Phytophagen in dem untersuchten Jahr verzehrt worden war. Diese Werte wurden zu den von uns gemessenen Laubgewichten addiert. Auf diese Weise haben wir das durch den Raupenfraßwert korrigierte (aktuell produzierte) Laubgewicht erhalten.

2. Verholzte und verholzende Teile

Nach beendetem Laubfall (November–Dezember) wurden die Mustersträucher gefällt, aufgrund deren die jährliche Sproß- und Ast + Stammproduktion abgeschätzt wurde. Die einjährigen Sprosse weichen in ihrer Farbe von den älteren Zweigen ab. Wir haben von den gefällten Mustersträuchern die einjährigen Sprosse abgeschnitten. Ihr Trockengewicht wurde genau so wie das der Blätter getrocknet und berechnet, auf diese Weise erhielten wir die jährliche Sproßproduktion.

Zur Abschätzung der Ast-Stamm-Produktion wurden die Sträucher in 10–12 cm grosse Stücke zerschnitten und nach ihrer Dicke gruppiert. Im weiteren haben wir die verholzte Produktion auf zweifache Weise abgeschätzt:

a) An den Ästen und Stämmen wurden mittels Jahresringenanalysen Altersbestimmungen durchgeführt. Die Dicke der in den letzten zwei Jahren entstandenen Jahresringe wurden an dem dünneren und stärkeren Ende einer jeden Probe gesondert gemessen. Wir berechneten das Volumen des äußeren Jahresringes. Die Proben wurden auf 85 °C bis zur Gewichtskonstanz getrocknet, sodann ihr Gewicht und Volumen gemessen. Wir bestimmten das spezifische Gewicht der verholzten Teile der einzelnen Arten. Das Produkt des Jahresringvolumens und des spezifischen Gewichtes ergab die Stamm-Ast-Produktion.

b) Im Laufe der Jahresringenanalyse haben wir das Alter der Proben erhalten (bei den hohen Sträuchern 9–11 Jahre, bei den niedrigen Sträuchern 2–5 Jahre). Die gemessenen Daten des Ast + Stamm-Trockengewichtes wurden mit dem durchschnittlichen Alter dividiert und auf diese Weise erhielten wir den Durchschnittswert der verholzten Jahresproduktion je nach Arten.

Die Abweichung der auf diese zweifache Weise gemessenen Daten beträgt ±1.7%. Bei unseren Ergebnissen haben wir den Durchschnitt der mit Hilfe dieser zwei Methoden gewonnenen Daten berücksichtigt.

3. Frucht

Im Interesse der Feststellung der Fruchtproduktion der Sträucher hat NAGY in 1978 sämtliche Früchte von 3 Straucharten (*Cornus mas, Euonymus verrucosus, Ligustrum vulgare*) auf dem Gebiet von einem Hektar eingesammelt und diese gemessen. Die Fruchtdaten der anderen untersuchten Straucharten sind nur geschätzte Werte (aufgrund der jahrelangen Beobachtungen).

Ergebnisse

Laubproduktion

Der Durchschnitt der Laubproduktion in den drei Jahren 1975–1977 beträgt 527,36 kg ha^{-1} Jahr^{-1} (Tabelle 1). Der Wert ist im wesentlichen identisch mit den in den Jahren 1973 (529,18 kg ha^{-1}), 1978 (544,19 kg ha^{-1}), bzw. 1979 (533,72 kg ha^{-1}) gemessenen Laubphytomassenwerten (Tabelle 2). Die Phytophagen verzehrten in der dreijährigen Periode durchschnittlich 10,6% des Strauchlaubes. Das entspricht einem Jahresgewicht von 62,75 kg ha^{-1}. Die gesamte Nettoproduktion machte demnach 590,12 kg ha^{-1} aus. Dieser Wert ist praktisch identisch mit der in 1973, 1978 und 1979 gemessenen durchschnittlichen Laubproduktion, da er hinsichtlich der ganzen Strauchschicht 600,17 kg ha^{-1} betrug. Zwischen dem Durchschnitt der Laubmenge der zweimal dreijährigen Periode zeigt sich nur eine Abweichung von 10,05 kg (1,6%).

87,64% (529,98 kg ha^{-1}) des Laubes wird von den 6050 Individuen der hohen Strauchschr itt produziert, während die Produktion der 87 404 Stücke

Tabelle 1

Jahresproduktion des Strauchlaubes in kg ha^{-1}

A = meßbares Gewicht; B = durch Raupen verzehrtes Gewicht; C = rekonstruiertes Gewicht (Produktion). Den Gang der Berechnung s. im Text

Straucheart	1975			1976			1977			1975–1977 (Durchschnitt)		
	A	B	C	A	B	C	A	B	C	A	B	C
Acer campestre	245,29	63,81	309,10	211,19	23,10	234,29	168,66	19,44	188,10	208,38	35,45	243,83
Acer tataricum	34,78	23,53	58,31	26,58	5,01	31,59	22,21	8,29	30,50	27,85	12,28	40,13
Cornus mas	202,05	5,81	207,86	204,08	2,12	206,20	176,09	3,23	179,32	194,07	3,72	197,79
Cornus sanguinea	36,41	3,06	39,47	30,21	1,97	32,18	29,28	1,49	30,77	31,96	2,17	34,14
Crataegus monogyna	2,15	0,24	2,39	1,69	0,14	1,83	1,84	0,04	1,88	1,89	0,14	2,03
Euonymus verrucosus	9,58	0,17	9,75	8,74	0,19	8,93	10,71	0,02	10,73	9,68	0,12	9,80
Ligustrum vulgare	17,60	1,08	18,68	10,88	0,78	11,66	15,63	0,17	15,80	14,70	0,68	15,38
Quercus petraea	28,44	16,75	45,20	32,26	2,94	35,20	36,35	4,13	40,48	32,35	7,94	40,29
Sonstige Sträucher	6,48	0,42	6,90	6,48	0,12	6,60	6,48	0,22	6,70	6,48	0,25	6,73
Total	582,78	114,87	697,66	532,11	36,37	568,48	467,25	37,03	504,28	527,36	62,75	590,12

Tabelle 2

Laubproduktion der Sträucher pro Hektar (in Trockensubstanz kg/Jahr)

Strauchart	Meßbares Laubgewicht								Durchschnittlicher Frasswert**		Durchschnittlicher rekonstruiertes Laubgewicht		
	1973		1978		1979*		Durchschnitt von 3 Jahren						
	a	m	a	m	a	m	a	m	a	m	a	m	insg.
Acer campestre	9,43	189,64	7,92	187,20	8,04	183,47	8,46	186,77	1,43	31,75	9,89	218,52	228,41
Acer tataricum	8,20	37,90	8,00	31,82	7,58	28,18	7,93	32,63	3,47	14,29	11,40	16,92	58,32
Cornus mas	2,60	182,68	2,25	191,16	2,23	216,39	2,36	196,74	0,04	3,93	2,40	200,67	203,07
Cornus sanguinea	11,99	17,80	9,88	20,40	10,18	24,20	10,65	20,80	0,72	1,41	11,37	22,21	33,58
Crataegus monogyna	3,05	—	2,10	—	2,51	—	2,55	—	0,18	—	2,73	—	2,73
Euonymus europaeus	2,33	—	3,16	—	2,93	—	2,81	—	0,11	—	2,92	—	2,92
Euonymus verrucosus	7,39	—	10,01	—	9,25	—	8,88	—	0,11	—	8,99	—	8,99
Ligustrum vulgare	12,97	2,60	13,48	2,78	12,95	3,65	13,14	3,01	0,60	0,14	13,74	3,15	16,89
Quercus petraea	6,30	30,15	7,80	26,12	5,73	23,50	6,62	26,59	1,62	6,51	8,24	33,10	41,34
Rosa canina	0,78	—	0,40	—	0,35	—	0,52	—	0,02	—	0,54	—	0,54
Sonstige Arten	1,67	1,70	1,92	1,44	2,06	0,99	1,89	1,37	0,07	0,05	1,96	1,42	3,38
Total	66,71	462,47	66,92	460,89	63,81	480,38	65,81	467,91	8,37	58,08	74,18	525,99	600,17

a = niedrige Strauchschicht
m = hohe Strauchschicht
* Aufgrund der Daten von E. Szabó.
** Berechnet aufgrund des Prozentwertes in den Jahren 1975–77.

ausmachenden niedrigen Sträucher 12,36% (74,18 kg ha^{-1}) ausmacht. Die meisten Blätter hat *Cornus mas* und *Acer campestre* entwickelt, nämlich 38,06, bzw. 33,84% der ganzen oberirdischen Produktion. Was die Hektarenfläche anbelangt, so zeigen Ligustrum vulgare und die »sonstigen« Sträucher ein verhältnismäßig geringes Blattgewicht.

Die jährliche Laubbildung wird in den verschiedenen Jahren in wechselndem Masse von den Phytophagengradationen beeinflußt. Die in den erwähnten Jahren verheerenden Phytophagen bevorzugten vor allem die Blätter von *Acer tataricum*, *A. campestre*, *Quercus petraea* und *Crataegus monogyna*. Im Jahre 1975 wurde bei *Acer tataricum* mehr als 40%, bei *Acer campestre* mehr als 20%, bei *Quercus petraea* mehr als 37% der Blattmenge verzehrt. Die Blätter von *Cornus mas*, *Euonymus verrucosus* und *Ligustrum vulgare* werden von den Phytophagen nicht dermaßen bevorzugt (jährlicher Raupenfraßdurchschnitt 1–4%). Es ist eine interessante Beobachtung, daß in den Jahren, in denen sich eine stärkere Phytophagengradation zeigte, die Gesamtproduktion der Strauchblätter trotzdem groß war. Diese Erscheinung kann dadurch erklärt werden, daß die beschädigten Blätter in diesen Jahren — ähnlich wie in der Laubkronenschicht — ihre fehlende Blattfläche durch neue Sommerblätter zu kompensieren versuchten, was letzten Endes zu der Erhöhung der Jahresblattproduktion führte.

Produktion der verholzten und verholzenden Teile

Die Gesamtproduktion der verholzten und verholzenden Organe beträgt 744,15 kg ha^{-1} $Jahr^{-1}$, deren 45,93% (341,73 kg) die einjährigen Sprosse, 54,07% (402,42 kg) dagegen das Ast + Stamm-Wachstum ausmacht. Die niedrigen Sträucher produzieren 97,87 kg (13,15%), die hohen Sträucher dagegen 645,28 kg (86,85%). Bei einer Hälfte der Arten (*Acer tataricum*, *Cornus mas*, *Euonymus europaeus*, *Ligustrum vulgare*, *Rosa canina*) zeigt die einjährige Sprossproduktion eine etwas größere Masse als bei der Ast + Stamm-Fraktion. In seiner Gesamtheit ist der Ast + Stamm-Teil um 60.69 kg (8,14%) größer als der der einjährigen Sprosse (Tabelle 3, 4).

Die zwei vorherrschenden Arten der hohen Strauchschicht — *Cornus mas* und *Acer campestre* — bilden den Großteil der eingesammelten verholzten und verholzenden Teile. Ihr Gesamtwert macht 72,40% (528,55 kg) dieser Fraktion aus. Die Werte der sonstigen Arten sind in abnehmender Reihenfolge: *Acer tataricum* (62,42 kg), *Cornus sanguinea* (44,74 kg), *Quercus petraea* (43,58 kg), *Ligustrum vulgare* (33,53 kg), *Euonymus verrucosus* (14,42 kg), *E. europaeus* (3,56 kg), *Crataegus monogyna* (3,62 kg), *Rosa canina* (1,67 kg). Die verholzende Gesamtproduktion der anderen Arten (in der hohen Strauchschicht: *Crataegus monogyna*, *Euonymus europaeus*, *E. verrucosus*, *Quercus cer-*

Tabelle 3

Nettoproduktion von einjährigen Sprossen der Sträucher pro Hektar in kg Jahr^{-1}

Strauchart	1977		1978		1979		Durchschnittlich		
	a	m	a	m	a	m	a	m	insgesamt
Acer campestre	2,11	62,33	2,18	64,56	2,56	85,76	2,28	70,88	73,16
Acer tataricum	3,29	12,28	4,02	29,11	4,42	42,98	3,91	28,12	32,03
Cornus mas	1,02	140,22	1,18	158,06	0,65	194,34	0,95	164,21	165,16
Cornus sanguinea	8,75	2,86	10,80	10,71	9,45	15,76	9,67	9,78	19,45
Crataegus monogyna	1,18	—	2,02	—	0,86	—	1,35	—	1,35
Euonymus europaeus	2,79	—	2,99	—	3,49	—	3,09	—	3,09
Euonymus verrucosus	7,52	—	6,70	—	7,01	—	7,08	—	7,08
Ligustrum vulgare	15,55	1,48	18,12	1,92	16,64	4,15	16,77	2,52	19,29
Quercus petraea	7,19	8,30	6,11	7,45	7,37	13,79	6,89	9,84	16,73
Rosa canina	1,11	—	1,59	—	1,31	—	1,34	—	1,34
Sonstige Arten	1,82	0,96	1,80	1,08	1,61	1,88	1,74	1,31	3,05
Total:	52,33	228,43	57,51	272,89	55,37	358,66	55,07	286,66	341,73

a = niedrige Strauchschicht
m = hohe Strauchschicht

Tabelle 4

Nettoproduktion der Sträucher an Ästen und Stämmen pro Hektar in kg Jahr^{-1}

Strauchart	1977		1978		1979		Durchschnittlich		
	a	m	a	m	a	m	a	m	insgesamt
Acer campestre	4,92	90,70	5,10	118,12	4,15	166,71	4,72	125,17	129,89
Acer tataricum	3,91	14,95	3,27	27,15	3,16	41,94	3,45	28,01	31,46
Cornus mas	1,02	109,63	1,18	161,12	1,16	209,05	1,12	159,93	161,05
Cornus sanguinea	6,81	13,06	6,09	18,01	5,92	25,99	6,27	19,02	25,29
Crataegus monogyna	2,29	—	1,99	—	2,54	—	2,27	—	2,27
Euonymus europaeus	0,70	—	0,51	—	0,47	—	0,56	—	0,56
Euonymus verrucosus	6,22	—	7,60	—	8,19	—	7,34	—	7,34
Ligustrum vulgare	10,95	1,44	11,94	2,27	10,55	5,58	11,14	3,10	14,24
Quercus petraea	4,02	16,63	3,19	21,41	3,96	31,31	3,73	23,12	26,85
Rosa canina	0,40	—	0,35	—	0,24	—	0,33	—	0,33
Sonstige Arten	1,66	0,87	1,92	1,18	2,03	1,76	1,87	1,27	3,14
Total:	42,90	247,28	43,14	349,26	42,37	482,34	42,80	359,62	402,42

a = niedrige Strauchschicht
m = hohe Strauchschicht

Tabella 5

Durchschnittliche oberirdische netto Produktion

Strauchart	Laub*			Einjähriger Sproß***		
	a	m	insgesamt	a	m	insgeasmt
Acer campestre	9,89	218,52	228,41	2,28	70,88	73,16
Acer tataricum	11,40	46,92	58,32	3,91	28,12	32,03
Cornus mas	2,40	200,67	203,07	0,95	164,21	164,56
Cornus sanguinea	11,37	22,21	33,58	9,67	9,78	19,45
Crataegus monogyna	2,73	—	2,73	1,35	—	1,35
Euonymus europaeus	2,92	—	2,92	3,09	—	3,09
Euonymus verrucosus	8,99	—	8.99	7,08	—	7,08
Ligustrum vulgare	13,74	3,15	16,89	16,77	2,52	19,29
Quercus petraea	8,24	33,10	41,34	6,89	9,84	16,73
Rosa canina	0,54	—	0,54	1,34	—	1,34
Sonstige Arten	1,96	1,42	3,38	1,74	1,31	3,05
Total:	74,18	525,99	600,17	55,07	286,66	341,73

* Mittlerer Wert von 3 Jahren (1973–78–79).
** In 1978 gemessene (+), bzw. geschätzte Werte von M. NAGY.
*** Durchschnitt von 3 Jahren (1977–78–79).

ris; in der niedrigen Strauchschicht: *Cerasus avium, Juglans regia, Quercus cerris, Rhamnus catharticus, Lonicera xylosteum, Sorbus domestica*) macht 0,83% (6,19 kg ha^{-1}) dieser Fraktion aus.

Fruchtproduktion

Laut unserer Beobachtungen vermehren sich die sich in dem untersuchten Wald entwickelnden Sträucher durch Würzlinge. Es gibt wenige blumentragende Sträucher, im Herbst kommen kaum reife Früchte vor. Die Fruchtproduktion der Arten der Strauchschicht erreichte in keinem Jahr 1% der Gesamtproduktion. Die Blüten erscheinen vor allem an den Waldrändern und auf Flecken unter kleinerer Laubkronenschließung, aber auch von diesen gelangen kaum einige bis zur Fruchtreife.

Gesamtproduktion

Die Nettoproduktion der oberirdischen Teile der Sträucher machte insgesamt 1347,30 kg ha^{-1} $Jahr^{-1}$ (in Trockengewicht) aus. 12,75% (172,24 kg) dieser Menge wird von den niedrigen Sträuchern, 87,25% (1175,06 kg) dagegen von den hohen Sträuchern produziert (Abb. 1). Von diesen drei Fraktionen

der Sträucher (kg/ha^{-1} Jahr^{-1})

Ast + Stamm***			Blüte und Frucht**	Total			Im Prozentwert der oberirdischen Phytomasse		
a	m	insgesamt		a	m	insgesamt	a	m	insgesamt
4,72	125,17	129,89	0,15	16,89	414,72	431,61	57,96	28,00	28,58
3,45	28,01	31,46	0,10	18,76	103,15	121,91	72,29	29,33	32,31
1,12	159,93	161,05	2,16+	4,47	526,97	531,44	29,01	25,36	25,38
6,27	19,02	25,29	0,20	27,31	51,21	78,52	75,73	36,47	44,49
2,27	—	2,27	0,05	6,40	—	6,40	27,46	—	27,46
0,56	—	0,56	—	6,57	—	6,57	67,87	—	67,87
7,34	—	7,34	0,14+	23,55	—	23,55	68,67	—	68,67
11,14	3,10	14,24	0,13+	41,65	8,90	50,55	77,99	26,75	58,33
3,73	23,12	26,85	—	18,86	66,06	84,92	62,90	35,50	39,31
0,33	—	0,33	—	2,21	—	2,21	94,04	—	94,04
1,87	1,27	3,14	0,05	5,57	4,05	9,62	71,31	25,03	40,10
42,80	359,62	402,42	2,98	172,24	1175,06	1347,30	64,11	29,49	47,86

ist die des Laubes (44,57%) am größten, die zwei anderen sind annähernd gleichwertig, nämlich die der einjährigen Sprosse (25,33%) und die des Ast + Stamm-Teiles (29,88%). Die Menge der Früchte und Blüten ist äußerst klein (Abb. 2).

Die für die ganze Strauchschicht charakteristische Verteilung ist natürlich im Falle der einzelnen Arten verschieden. So sind z. B. die Prozentwerte
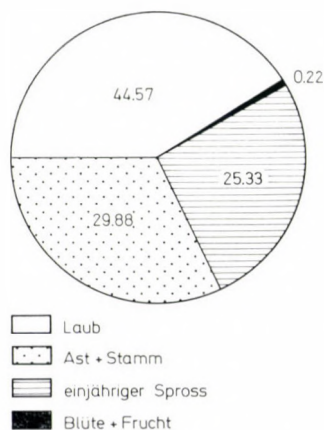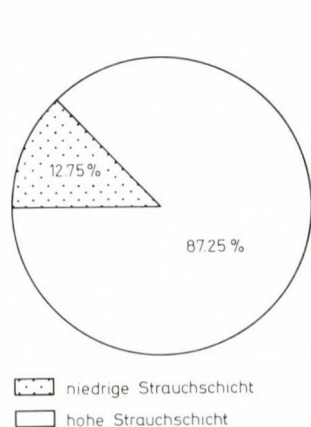
Abb. 1. Verteilung der Produktion zwischen der hohen und niedrigen Strauchschicht

Abb. 2. Prozentuale Verteilung der Nettoproduktion je nach Fraktionen
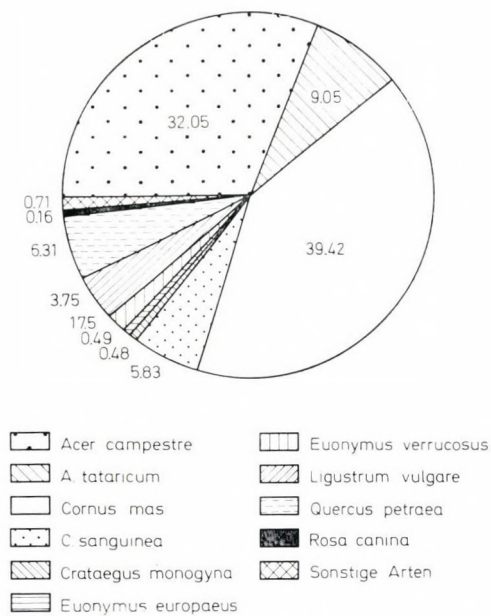
Abb. 3. **Prozentuale Verteilung der Nettoproduktion der Sträucher je nach Arten**
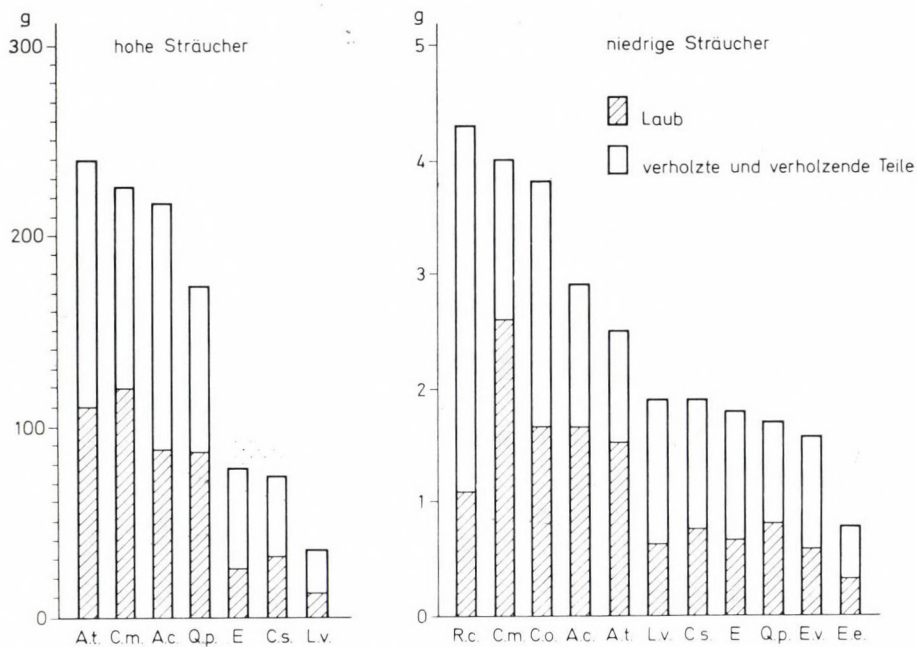
Abb. 4. **Produktion der Sträucher in g Ind.$^{-1}$ Jahr^{-1}**

in der Laub — einjähriger Sproß — Ast + Stamm-Produktion bei *Acer campestre* 53–17–30%, bei *Cornus mas* dagegen 38–31–31%, bei *Ligustrum vulgare* 33–39–28%. Tabelle 5 und Abb. 3 zeigen die Verteilung der Gesamtproduktion je nach Arten.

Die Vegetationsperiode umfaßt auf dem untersuchten Gebiet durchschnittlich 207 Tage. Diese Tatsache berücksichtigend macht die durchschnittliche Tagesproduktion der Sträucher 0,64 g m^{-2} aus, was 12,3% der Gesamtproduktion der Bäume bedeutet. Aus den Nettoproduktionswerten der einzelnen Arten wurden das je auf einen Strauch fallenden durchschnittliche jährliche Wachstumsgewicht berechnet (die Produktion je nach Hektaren wurde mit der Zahl der niedrigen, bzw. hohen Sträucher dividiert). Abb. 4 gibt die Gestaltung des Jahreswachstums je nach Unterschichten an. Aus dem Graphikon erhellt sich deutlich, daß zwischen der auf ein Individuum fallenden Produktionsmenge und den strukturellen Parametern (Höhe, Deckung, usw.) des Strauches eine enge Korrelation zu beobachten ist. Das jährliche Gewichtszunahme ist auch bei den einzelnen Individuen der hohen Straucharten proportioniert höher als die kleine Masse zeigenden Produkte der niedrigen Sträucher.

Wir haben die oberirdische Produktion der einzelnen Arten im Prozentwert der oberirdischen Phytomasse ausgedrückt (Tabelle 5). Diese Prozentwerte sind in der niedrigen Strauchschicht wesentlich höher als in der hohen Strauchschicht, was jedoch darauf hinweist, daß sich die kleinen, jungen Sträucher intensiver entwickeln.

Es wurde in einer extra Tabelle die Schwankung vom Durchschnitt der in den verschiedenen Jahren gemessenen Produktionsfraktionen zusammengefaßt (Tabelle 6). Die größte Abweichung vom Durchschnitt zeigte sich bei

Tabelle 6

Abweichungen vom Durchschnitt der in den verschiedenen Jahren gemessenen Produktionswerte je nach Fraktionen (kg ha^{-1}, bzw. %)

	Durchschnitt	Abweichung vom Durchschnitt					
		1973	1975	1976	1977	1978	1979
Laub	600,17 (100%)	−4,54 (0,7%)	+97,49* (16,2%)	−31,69* (5,2%)	−95,89* (15,9%)	−5,91 (0,9%)	+10,47 (1,7%)
Einjähriger Sproß	341,73 (100%)	—	—	—	−60,97 (17,8%)	−11,33 (3,2%)	+72,30 (21,1%
Ast + Stamm	402,42 (100%)	—	—	—	−112,25 (27,9%)	−10,03 (2,4%)	+122,28 (30,4%)
Frucht	2,98	—	—	—	—	—	—
Gesamte Produktion	1347,30 (100%)	—	—	—	−269,10 (20,1%)	−17,26 (1,2%)	+205,05 (15,2%)

*Im Verhältnis zum Durchschnitt der Jahre 1973–1978–1979.

dem 1979 gemessenen Ast + Stamm-Fraktionswert (+30,4%). Die Abweichungen bei den übrigen Fraktionen sind kleiner. Sämtliche oberirdische Produktion betrachtet, ist die Abweichung in 1977 am größten (−20,1%).

In der Literatur behandeln die sich mit der Produktion der Wälder befassenden Autoren nur selten auch die Sträucher. Die Ergebnisse sind im allgemeinen nicht nach den einzelnen Arten, sondern nach den einzelnen Assoziationen angegeben (Hytteborn 1975; Ovington–Heitkamp–Lawrence 1963; Lieth 1975) und so besteht keine Möglichkeit eines vielseitigen Vergleichs. Die in den verschiedenen Pflanzengesellschaften des Great Smoky Mountains durchgeführten Untersuchungen bilden eine Ausnahme, da im Laufe dieser die Produktionsverhältnisse von 14 (teilweise laubabwerfenden, teilweise immergrünen) Straucharten behandelt wurden (Whittaker 1961, 1962; Whittaker–Garfine 1962).

Die individuelle Triebproduktion der Sträucher des Síkfőkúter Eichenwaldes bewegt sich bei den hohen Sträuchern zwischen 34,7–239,8 g Jahr^{-1}. Ähnliche Ergebnisse wie auch Whittaker auf (1962), er veröffentlichte für die Jahrestriebproduktion der laubabwerfenden Arten Daten zwischen 27,4 und 145,3 g Jahr^{-1}. Die Triebproduktionen zeigen außer *Rhododendron maximum* eine ähnliche Größenordnung (43,3–214,3 g Jahr^{-1}). Die Daten des Verhältnisses Triebproduktion-Blattflächeneinheit sind zum Vergleich geeignet. Dieser Wert bewegt sich in dem von uns untersuchten Eichenwald zwischen 66,88–171,22 g m^{-2} Jahr^{-1} (Tabelle 7). Ähnliche Daten veröffentlichte Whittaker (1962) bei *Viburnum alnifolium* (67,1 g m^{-2} Jahr^{-1}), *Lyonia ligustrina* (139,0 g m^{-2} Jahr^{-1}), *Vaccinium constablaei* (205,0 g m^{-2} Jahr^{-1}). Laug Ovington (1957) produziert eine 1 m^2 große Blattfläche jährlich im allgemeinem 50–80 g Triebtrockensubstanz. Bei *Pinus silvestris* hat er 180 g m^{-2} gemessen. Suba untersuchte 1979–1980 die Síkfőkúter Arten unter optimalen ökologischen Verhältnissen

Tabelle 7

Durchschnittliches Alter der Strauchindividuen, die Akkumulationsrate der Biomasse, ihre Nettoproduktion und die auf eine Blattflächeneinheit fallenden Werte der Triebproduktion

Strauchart	Triebphytomasse		Durchschnittliches Alter (Jahr)		Netto Triebproduktion, g Ind.$^{-1}$ Jahr^{-1}		Triebproduktion Blattfläche, g/m^2	Triebproduktion (Blattfläche unter optimalen Umständen, mittels ^{14}C-Isotope gewonnenen Ergebnisse*), g/m^2
	Trieb	Produktion						
	a	m	a	m	a	m		
Acer campestre	1,7	3,5	4	16	2,9	217,7	66,88	119,32
Acer tataricum	1,3	3,4	4	11	2,5	239,8	171,22	274,25
Cornus mas	2,9	3,9	7	11	4,0	225,6	120,29	536,67
Cornus sanguinea	1,3	2,7	3	9	2,0	74,2	82,39	—
Crataegus monogyna	3,6	—	8	—	3,8	—	130,61	254,07
Euonymus europaeus	1,4	—	2	—	0,8	—	121,66	167,38
Euonymus verrucosus	1,4	—	5	—	1,6	—	69,67	630,80
Ligustrum vulgare	1,2	3,7	2	12	2,0	34,7	97,77	679,80
Quercus petraea	1,5	2,8	3	7	1,7	172,9	111,73	—
Rosa canina	1,06	—	2	—	4,3	—	116,31	—

* Ergebnisse von J. Suba (Mscr.).

(8–10 000 Lux, 25–26 °C, dreifache CO_2-Konzentration, dampfgesättigter Luftraum, usw.) und erhielt anderthalb — zweimal größere Ergebnisse (Suba mscr.). Bei Arten, die das Licht gut ausnützen (*Cornus mas*, *Ligustrum vulgare*, *Euonymus verrucosus*) erreichen die Werte das vier-neunfache der von mir gemessenen Triebproduktionsdaten. Diese Arten sind — ausser *Cornus mas* — auf dem untersuchten Gebiet kleinwüchsig und im allgemeinen mehrfach bedeckt vom Laub der Bäume und der hohen Sträucher. Es ist demnach wahrscheinlich, daß die unter natürlichen Umständen gemessenen Daten durch die schwachen Lichtverhältnisse erklärt werden können.

Die Entwicklung und Änderung von Habitus und Struktur der terrestrischen Ökosysteme hängt in bedeutendem Masse von der Größe der Biomassenakkumulation ab. In Tabelle 7 haben wir die Proportionen der Biomassenakkumulation angegeben (Triebphytomasse, Triebproduktion). Im Falle der niedrigen Sträucher sind diese Werte denen der krautartigen Pflanzen ähnlich (im allgemeinen 1,8), bei den hohen Sträuchern bewegen sie sich zwischen 2,7 und 3,9. Whittaker (1962) veröffentlichte höhere Werte.

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Acta Botanica Academiae Scientiarum Hungaricae, Vol. 27 (3—4), pp. 383—402 (1981)

PROBREVAXONES, A NEW POLLEN GROUP FOR THE FIRST *BREVAXONES* FORM-GENERA FROM THE UPPER CENOMANIAN OF PORTUGAL

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(Received January 9, 1980)

During our investigations of the Upper Cenomanian strata of Vila Flor we have observed large numbers of pollen grains of the *Brevaxones* type which exhibit a primitive germinal area. Essentially the germinal aperture is tricolporate with no vestibulum or other form of differentiation. The exoaperture is a relatively short furrow and there is no infratectal and/or foot layer separation. Description of several new taxa are given including the new form genera *Bolchovitinaepollenites*, *Laingipollenites*, *Samoilovichaepollenites*, *Medusipollenites* and *Vilaflorpollenites*. Morphological analysis of the *Probrevaxones* shows that the pollen genera included here represent a stage of evolution, which encompasses a number of different evolutionary lines. The transition between the tricolporate (*Longaxones*) and *Brevaxones* occurs in several ways. In this respect the heterogenous character of the *Normapolles* is clear.

Introduction

The first reports on the spore-pollen assemblages of Vila Flor and Carrajão were published in 1974/1977 by DINIZ, KEDVES and SIMONCSICS. A Turonian age for the assemblages was suggested. SOLÉ DE PORTA (1978) described a spore-pollen assemblage from Oviedo. The strata from this locality are dated as Upper Cenomanian (*Rotalipora greenhornensis* ZONE) based on the foraminiferal studies of MENDENEZ FERNANDEZ. Because the spore-pollen assemblages of Oviedo and Vila Flor are so similar we now believe that the Vila Flor strata are probably Upper Cenomanian.

We are engaged in a wide-ranging palynological investigation of the sporomorphs of the Upper Cretaceous of Portugal and have now finished the study of the angiosperm pollen grains from Vila Flor. In this paper the first *Brevaxones* will be discussed for which we have created new taxa. Discussions and descriptions of the *Normapolles* and *Longaxones* will be published at a later date.

Material and methods

Locality descriptions and other sample information were published earlier (see DINIZ, KEDVES and SIMONCSICS 1974/1977). Preliminary light microscope investigations took about two months. The second stage of qualitative and quantitative analysis of the slides was done using oil immersion (obj. n = 100x). TEM studies were done parallely with the light microscope investigations and SEM studies are in progress.

Results

Probrevaxones

Brevaxones, triaperturate pollen grains. Exoapertures in general short furrows or pores, endoapertures pores. No thickening in the germinal region and no separation of the tectum, infratectum and foot layer or nexine. The extraapertural exine may be partially thickened.

Remarks. — The tricolporate character of the germinal structure serves to differentiate the *Probrevaxones* from the *Normapolles*. In the literature, under different names, a lot of information has been given about this group. Fig. 1 shows the distribution of these pollen grains during the Cenomanian and Turonian Stages. Unfortunately a precise age for the Australian locality is not known — DETTMANN and PLAYFORD (1978) — so we have used a neutral sign. The first data on this subject were published by BOLKHOVITINA (1953) from West Kazakhstan. For the distribution map, the following papers were relied on: AZEMA, DURAND and MÉDUS (1972), DOYLE and ROBBINS (1977), HERNGREEN (1973), KOMAROVA (1973), LAING (1975, 1976), MÉDUS and TRIAT (1969), PACLTOVÁ (1971), PADEN PHILLIPS and FELIX (1971), POKROVSKAIA (1966a, b), PONOMARENKO (1966), SAMOILOVICH (1965), SKURATENKO (1966).

It is important to note that the *Probrevaxones* have a cosmopolitan distribution, thus suggesting that the *Normapolles* and other types of pollen grains may have developed from them.
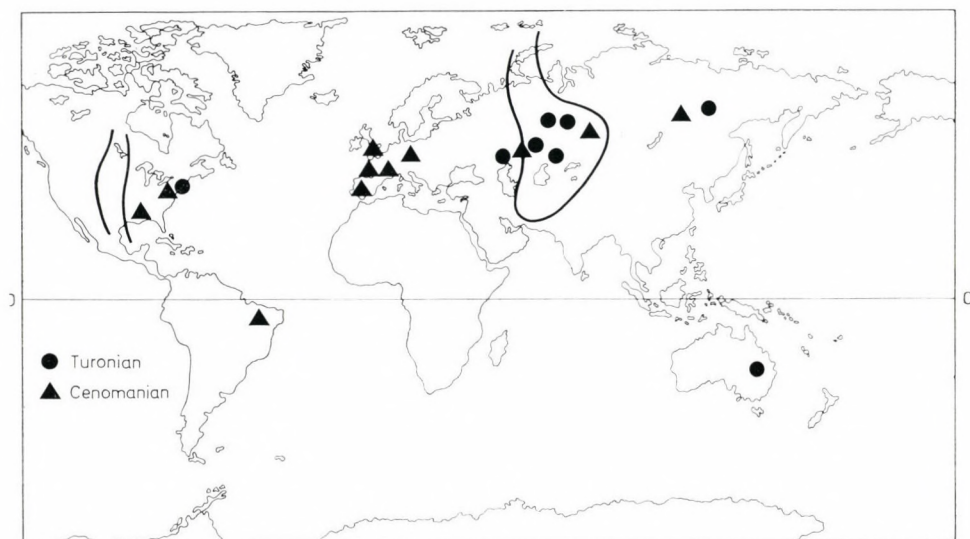
Fig. 1. Geographical distribution of the *Probrevaxones*

From the literature the following form-genera may be included here:

1. *Tenerina* W. Kr. 1959b

This is a very problematical form-genus. According to Krutzsch (1959b) the apertures are single, and the exine is probably one-layered. It will be very important to obtain TEM and SEM information about these pollen grains. Our observations on a few specimens are as follows:

1. *Tenerina tenera* W. Kr. 1959b (Plate I, Figs 1, 2)

The observed forms along with the earlier published specimens are not convincing as regards an Angiosperm origin.

2. Cf. *Tenerina* fsp. (Plate I, Figs 3, 4)

This is a true Angiosperm pollen, exine with tectum, columellar infratectal layer, and sexine. It is noteworthy that one of the germinal aperture regions is similar to that of the triangular *Brevaxones* pollen grains. Therefore this may represent an intermediate type.

2. *Perucipollis* Pacltová 1971

These pollen grains are triporate according to Pacltová's (1971) diagnosis. But from the literature on this subject, it seems that the exoapertures are small colpi. This genus is in question and a revision based on the SEM method is desirable.

The situation is similar with respect to the species of Paden Phillips and Felix (1971) and Laing (1975). These species were classed in the form-genus *Triporopollenites* Pf. 1953. We must emphasize, that it is not possible to have *Postnormapolles* taxa before or together with the first early *Normapolles* (*Complexiopollis* W. Kr. 1959b em. Tschudy 1973).

Remarks. — Mr. J. F. Laing re-examined his species, and based on his letter 20th June 1979 the new establishments are as follows: "On re-examination it does seem that curtisi has very short colpi (approximately 3–4 μm in length) although they are rather indistinct. I am unable to observe any colpi, however, on worbarrowensis and I suspect that if colpi do occur they will only be visible under SEM observation."

3. *Monstruosipollis* W. Kr. 1959b

4. ***Bolchovitinaepollenites* n. fgen.**

Fgen. type: *Bolchovitinaepollenites punctatus* **n. fsp.** (Plate I, Figs 5–11)

Diagnosis

Ambitus triangular with convex or straight sides. Surface scabrate, punctate, reticulate, rugulate, verrucate. Exoapertures short colpi, endoapertures pori. The exine has the same thickness in the apertural and in the extraapertural region, or it is sometimes a little thinner in the apertural region.

Locus typicus: Vila Flor (Portugal).

Stratum typicum: carbonaceous clay.

Derivatio nominis: In honour of Prof. Dr. N. Bolkhovitina.

Differential diagnosis: The lack of the endannulus separates this genus from *Atlantopollis* W. Kr. 1967. *Perucipollis* Pacltová 1971 may be compared to our new genus, but the surface of the Pacltová's (1971) genus is smooth.

Stratigraphical distribution: Upper Cenomanian and probably Turonian.

1. *Bolchovitinaepollenites punctatus* **n. fsp.** (Plate I, Figs 5–11)

Diagnosis

Ambitus triangular with straight or slightly concave sides. Surface punctate. Exine is about 1–1.5 μ thick, and the three layers of the ectexine are very well shown by light microscopy. Infratectal layer is columellar. Exoapertures are very small colpi, the endoapertures are pori and have the same diameter as the exoapertures.

Diameter: 15–24 μ.

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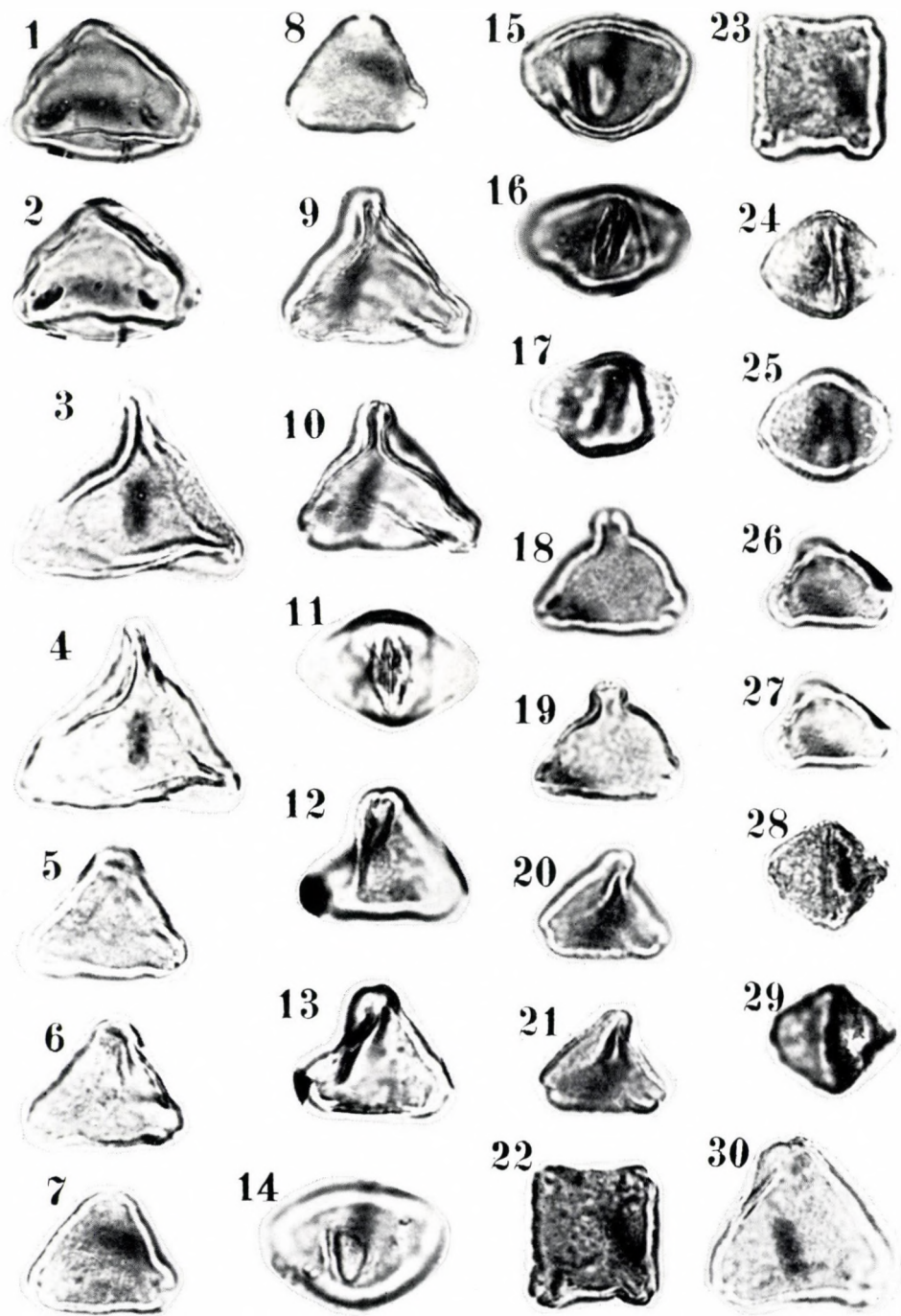

Holotype: Plate I, Figs 5, 6, slide Vila Flor esc. 3/3–10, co-ordinates 6.8/104.1.
Locus typicus, stratum typicum see above.
Derivatio nominis: From the surface ornamentation of the pollen grains.
Differential diagnosis: There is a certain resemblance to *Scabratriporites legibilis* SAMOILOVICH 1965, but there is a very characteristic thinning of the exine in the aperture region (p. 133, Fig. 12b in SAMOILOVICH 1965), that is atrium like. This is the main differential characteristic feature.
Occurrence: Vila Flor casa-1, 2, 3, Vila Flor esc. 2/1, 2/2, 2/3, 3/3, 3/4.

2. *Bolchovitinaepollenites granulatus* **n. fsp.** (Plate I, Figs 12–17)

Diagnosis

Ambitus triangular, with straight or concave sides. Surface finely granulate. Exine 1–1.5 μ thick, with the three layers of the ectexine having the same thickness. Infratectal layer elements are not clearly observable by optical microscope. Exoapertures are small, and the short colpi are about 4 μ long. Endoapertures are very tiny pores.
Diameter: 18–24 μ.

Holotype: Plate I, Figs 12, 13, slide Vila Flor casa 1/14, co-ordinates 12.5/110.2.
Locus typicus: Vila Flor (Portugal).
Stratum typicum: carbonaceous clay.
Derivatio nominis: From the characteristic surface ornamentation.

←

Plate I

Figs 1, 2. Tenerina tenera W. KR. 1959b, slide Vila Flor esc. 3/3–5; co-ordinates 7.3/108.1
Figs 3, 4. Cf. *Tenerina* fsp., slide Vila Flor casa 1/18; co-ordinates 11.3/116.1
Figs 5, 6. Bolchovitinaepollenites punctatus n. fgen. et fsp., slide Vila Flor esc. 3/3–10; co-ordinates 6.8/104.1
Figs 7, 8. Bolchovitinaepollenites punctatus n. fgen. et fsp., slide Vila Flor esc. 2/1–9; co-ordinates 6.6/105.4
Figs 9, 10. Bolchovitinaepollenites punctatus n. fgen. et fsp., slide Vila Flor esc. 2/3–6; co-ordinates 11.3/102.3
Fig. 11. Bolchovitinaepollenites punctatus n. fgen. et fsp., slide Vila Flor casa 1–17; co-ordinates 7.0/104.9
Figs 12, 13. Bolchovitinaepollenites granulatus n. fgen. et fsp., slide Vila Flor casa 1/4; co-ordinates 12.5/110.2
Figs 14, 15. Bolchovitinaepollenites granulatus n. fgen. et fsp., slide Vila Flor esc. 2/3–6; co-ordinates 12.1/107.2
Figs 16, 17. Bolchovitinaepollenites granulatus n. fgen. et fsp., slide Vila Flor esc. 2/3–7; co-ordinates 15.6/109.1
Figs 18, 19. Bolchovitinaepollenites miniverrucatus n. fgen. et fsp., slide Vila Flor casa 1/18; co-ordinates 9.4/103.8
Figs 20, 21. Bolchovitinaepollenites miniverrucatus n. fgen. et fsp., slide Vila Flor esc. 3/2–8; co-ordinates 19.5/113.4
Figs 22, 23. Bolchovitinaepollenites miniverrucatus n. fgen. et fsp., slide Vila Flor casa 1/15; co-ordinates 6.7/110.7
Figs 24, 25. Bolchovitinaepollenites miniverrucatus n. fgen. et fsp., slide Vila Flor esc. 2/1–9; co-ordinates 12.2/117.1
Figs 26, 27. Bolchovitinaepollenites microreticulatus n. fgen. et fsp., slide Vila Flor casa 2/3–6; co-ordinates 14.6/110.3
Figs 28, 29. Bolchovitinaepollenites microreticulatus n. fgen. et fsp., slide Vila Flor esc. 2/3–6; co-ordinates 10.1/103.6
Fig. 30. Bolchovitinaepollenites azemae n. fgen. et fsp. subfsp. *azemae*, slide Vila Flor esc. 3/2–2; co-ordinates 11.2/104.3 × 1000

Differential diagnosis: It is the surface ornamentation only, which differs from *B. punctatus* n. fsp. It must be emphasized, that intermediate specimens may be present between the above mentioned two species.
Occurrence: Vila Flor casa 1, Vila Flor esc. 2/1, 2/3, 3/3.

3. *Bolchovitinaepollenites miniverrucatus* **n. fsp.** (Plate I, Figs 18–25)

Diagnosis

Ambitus triangular, with straight or convex sides. Surface sculptured with large granules or with tiny verrucae. The basal diameter of the sculptural elements is 0.5 μ. Sometimes the sculptural elements anastomose thus producing a verrucate surface. The exine is 1 μ thick with the infratectal layer being thinner than the tectum and the foot layer. The exoapertures are 4–6 μ long, the colpi are small, and the endoapertures are very small pores.
Diameter: 15–20 μ.

Holotype: Plate I, Figs 18, 19, slide Vila Flor casa 1/18, co-ordinates 9.4/103.8.
Locus typicus: Vila Flor (Portugal).
Stratum typicum: carbonaceous clay.
Derivatio nominis: From the characteristic surface ornamentation.
Differential diagnosis: The characteristic small verrucae serve to distinguish this n. fsp. from the above described species of the form-genus.
Occurrence: Vila Flor casa-1, 2, Vila Flor esc. 2/1, 3/2.

4. *Bolchovitinaepollenites microreticulatus* **n. fsp.** (Plate I, Figs 26–29)

Diagnosis

Ambitus triangular with straight or concave sides. The surface is finely reticulate, although this ornamentation is sometimes difficult to observe. The mesh of the sculpture is less than 0.5 μ, and the muri are very thin. The exine thickness is about 1.5 μ with the infratectal layer being thicker than the tectum and the foot layer. The exoapertures are relatively long but small colpi. The endoapertures are tiny pori.
Diameter: 15–22 μ.

Holotype: Plate I, Figs 26, 27, slide Vila Flor casa 2/3–6, co-ordinates 14.6/110.3.
Locus typicus: Vila Flor (Portugal).
Stratum typicum: carbonaceous clay.
Derivatio nominis: From the sculpture of the pollen grains.
Differential diagnosis: The nature of the surface ornamentation separates this taxon from the other form-species of this form-genus.
Occurrence: Vila Flor casa-1, 2, Vila Flor esc. 2/1, 2/3.

5. *Bolchovitinaepollenites azemae* **n. fsp.** subfsp. *azemae* **subfsp. n.** (Plate I, Fig. 30, Plate II, Figs 1–5)

Diagnosis

Ambitus triangular, with straight, or convex or concave sides. Surface finely rugulate, with the sculptural elements being 0.5–1.5 μ in size. Between the rugulate sculptural elements there are also some small verrucae. Exoapertures are relatively long (6–8 μ) colpi, the endoapertures are small pori. The ectexine is 1–1.5 μ thick, with the tectum, and the infratectal layer having the same thickness.
Diameter: 18–25 μ.

Holotype: Plate I, Fig. 30, plate II, Fig. 1, slide Vila Flor esc. 3/2–2, 11.2/104.3.
Locus typicus: Vila Flor (Portugal).

Stratum typicum: carbonaceous clay.
Derivatio nominis: In honour of Dr. C. AZEMA, an excellent investigator of Cretaceous sporomorphs.
Differential diagnosis: The very characteristic surface ornamentation serves to distinguish this taxon from the other species of the form-genus.
Occurrence: Vila Flor esc. 2/1, 2/3, 3/2, 3/3.

5bis. *Bolchovitinaepollenites azemae* **n. fsp.** subfsp. *minor* subfsp. n. (Plate II, Figs 6, 7)

Diagnosis

The diameter of the specimens is 14–20 μ. The surface ornamentation is a little less pronounced than that of the previous subfsp. In the apertural region there is a very small thinning of the ectexine.
Diameter: 14–18 μ.

Subfsp. type: Plate II, Figs 6, 7, slide Vila Flor esc. 3/2–5, co-ordinates 9.3/114.5.
Holotype: Vila Flor (Portugal).
Stratum typicum: carbonaceous clay.
Derivatio nominis: From the small size as compared to the other form species.
Occurrence: Vila Flor esc. 2/1, 3/2.

6. *Bolchovitinaepollenites teixerai* **n. fsp.** (Plate II, Figs 8–11)

Diagnosis

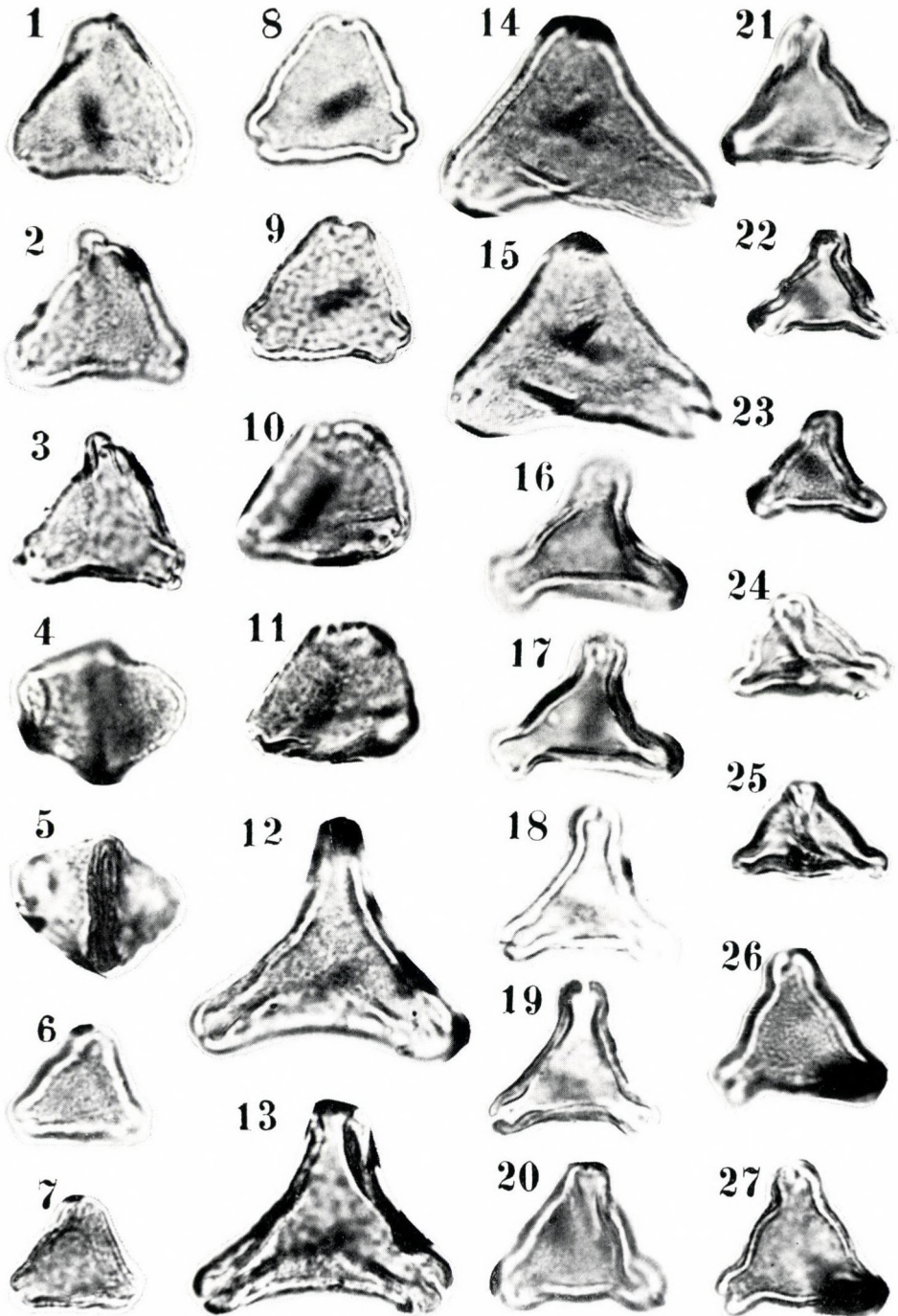
Ambitus triangular, with straight or slightly convex sides. Apertural region is fairly prominent. Surface verrucate, or rugulate, the bases of the sculptural elements are 1.3–2 μ. The exine is 1–1.3 μ thick, with the tectum, infratectal layer and the foot layer having the same thickness. The exine near the exoapertures unfold in the direction of the centre of the pollen. Colpi short and relatively large (0.6–1 μ). Endoapertures small pori.
Diameter: 18–25 μ.

Holotype: Plate II, Figs 8, 9, slide Vila Flor casa 1/7, co-ordinates 8.2/111.1.
Locus typicus: Vila Flor (Portugal).
Stratum typicum: carbonaceous clay.
Derivatio nominis: In honour of Prof. Dr. C. TEIXEIRA.
Differential diagnosis: The larger sculptural elements easily distinguish this species from *B. miniverrucatus* n. fsp., and from *B. azemae* n. fsp.
Occurrence: Vila Flor casa-1,2, Vila Flor esc. 2/1, 3/2, 3/3.

7. *Bolchovitinaepollenites durandae* **n. fsp.** (Plate II, Figs 12–15)

Diagnosis

Ambitus concave. Surface finely rugulate. Size of the sculptural elements varies from 0.5 to 1.5 μ. The exine is 1–1.8 μ thick. The three layers, tectum, infratectal layer and foot layer, have the same thickness. Colpi relatively long, about 8 μ, endopori relatively large.
Diameter: 23–34 μ.

Holotype: Plate II, Figs 12, 13, slide Vila Flor esc. 2/1–9, co-ordinates 16.6/119.3.
Locus typicus: Vila Flor (Portugal).
Stratum typicum: carbonaceous clay.
Derivatio nominis: From the equatorial outline.

Differential diagnosis: The large size, and the characteristic outline separate *B. durandae* from *B. azemae* n. fsp. and *B. teixerai* n. fsp.
Occurrence: Vila Flor esc. 2/1.

5. *Laingipollenites* **n. fgen.**
Fgen. type: *Laingipollenites vilaflorensis* **n. fsp.** (Plate II, Figs 16–21)

Diagnosis
Triangular, triaperturate pollen. Exoapertures short colpi, endoapertures pori. Surface smooth, or sculptured, scabrate, punctate, verrucate, rugulate, etc. The apertural region is prominent.

Locus typicus: Vila Flor (Portugal).
Stratum typicum: carbonaceous clay.
Derivatio nominis: In honour of Dr. J. LAING.
Differential diagnosis: The prominent apertural area distinguishes this taxon from *Bolchovitinaepollenites* n. fgen.
Stratigraphical distribution: Apparently upper Cenomanian only.
1. *Laingipollenites vilaflorensis* **n. fsp.** (Plate II, Figs 16–21)

Diagnosis
Ambitus concave, or convex with very prominent apertural characteristics. Surface scabrate to punctate. Exine 1.5–2 μ thick, the infratectal layer is thinner than the outer and the inner ectexine layer. Exoapertures short (3–4 μ long), small colpi, endoapertures pori, about 0.6 μ in diameter.
Diameter: 18–24 μ.

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Plate II

Fig. 1. Bolchovitinaepollenites azemae n. fgen. et fsp. subfsp. *azemae*, slide Vila Flor esc. 3/2–2; co-ordinates 11.2/104.3
Figs 2, 3. Bolchovitinaepollenites azemae n. fgen. et fsp. subfsp. *azemae*, slide Vila Flor esc. 3/3–7; co-ordinates 10.5/108.3
Figs 4, 5. Bolchovitinaepollenites azemae n. fgen. et fsp. subfsp. *azemae*, slide Vila Flor esc. 3/2–4; co-ordinates 11.6/108.8
Figs 6, 7. Bolchovitinaepollenites azemae n. fgen. et fsp. subfsp. *minor* n. subfsp., slide Vila Flor esc. 3/2–5; co-ordinates 9.3/114.5
Figs 8, 9. Bolchovitinaepollenites teixerai n. fgen. et fsp., slide Vila Flor casa 1/7; co-ordinates 8.2/111.1
Figs 10, 11. Bolchovitinaepollenites teixerai n. fgen. et fsp., slide Vila Flor esc. 2/1–7; co-ordinates 15.7/116.2
Figs 12, 13. Bolchovitinaepollenites durandae n. fgen. et fsp., slide Vila Flor esc. 2/1–9; co-ordinates 16.6/119.3
Figs 14, 15. Bolchovitinaepollenites durandae n. fgen. et fsp., slide Vila Flor esc. 2/1–3; co-ordinates 16.7/117.1
Figs 16, 17. Laingipollenites vilaflorensis n. fgen. et fsp., slide Vila Flor esc. 3/2–6; co-ordinates 7.9/107.4
Figs 18, 19. Laingipollenites vilaflorensis n. fgen. et fsp., slide Vila Flor esc. 3/3–1; co-ordinates 8.1/107.7
Figs 20, 21. Laingipollenites vilaflorensis n. fgen. et fsp., slide Vila Flor casa 2/10; co-ordinates 18.7/111.1
Figs 22, 23. Laingipollenites minor n. fgen. et fsp., slide Vila Flor esc. 2/1–2; co-ordinates 16.6/111.1
Figs 24, 25. Laingipollenites minor n. fgen. et fsp., slide Vila Flor esc. 3/3–10; co-ordinates 13.1/117.3
Figs 26, 27. Laingipollenites microverrucatus n. fgen. et fsp., slide Vila Flor esc. 2/1–8; co-ordinates 14.6/111.3. ×1000

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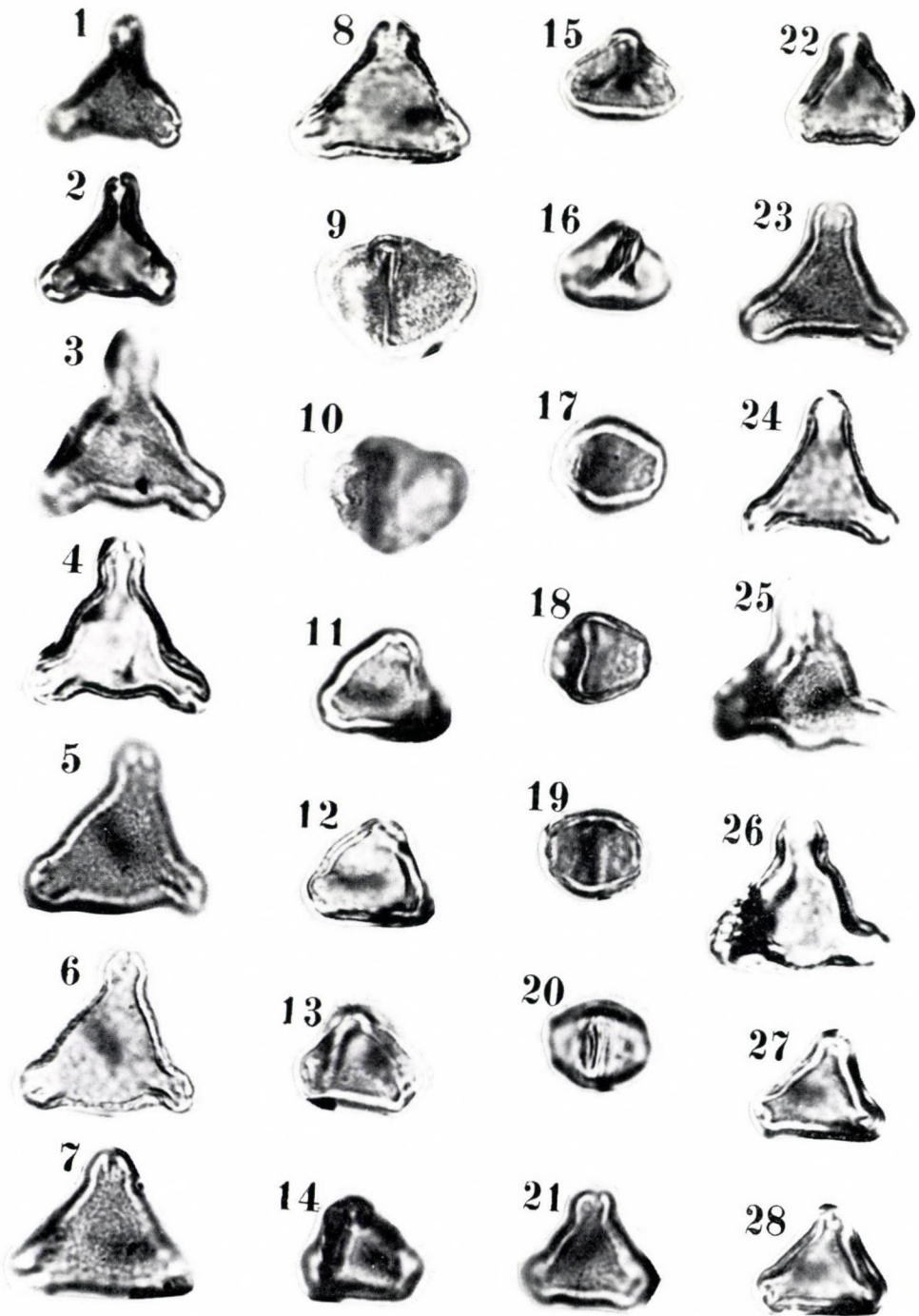
Holotype: Plate II, Figs 18, 19, slide Vila Flor esc. 3/3–1, co-ordinates 8.1/107.7.
Locus typicus: Vila Flor (Portugal).
Stratum typicum: carbonaceous clay.
Derivatio nominis: From the locality type.
Occurrence: Vila Flor casa-2, Vila Flor esc. 3/2, 3/3.

2. *Laingipollenites minor* **n. fsp.** (Plate II, Figs 22–25)

Diagnosis

Ambitus triangular with convex sides. Apertural region very prominent. Surface granular to very finely rugulate, the diameter of the sculptural elements is about 0.5 μ. Exine is 1.2–1.4 μ thick with the three ectexine layers having the same thickness. Exoapertures very small colpi, the endoapertures are tiny pores.
Diameter: 14–20 μ.

Holotype: Plate II, Figs 22, 23, slide Vila Flor esc. 2/1–2, 16.6/111.1.
Locus typicus: Vila Flor (Portugal).
Stratum typicum: carbonaceous clay.
Derivatio nominis: From the small size of the pollen.
Differential diagnosis: The small size and the fine sculpture differentiate this taxon from the above described form-species.
Occurrence: Vila Flor esc. 2/1, 3/2, 3/3.

3. *Laingipollenites microverrucatus* **n. fsp.** (Plate II, Figs 26, 27, Plate III, Figs 1–10)

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Plate III

Figs 1, 2. Laingipollenites microverrucatus n. fgen. et fsp., slide Vila Flor casa 1/21; co-ordinates 14.8/106.1
Figs 3, 4. Laingipollenites microverrucatus n. fgen. et fsp., slide Vila Flor esc. 3/3–7; co-ordinates 13.2/108.5
Figs 5, 6. Laingipollenites microverrucatus n. fgen. et fsp., slide Vila Flor esc. 3/2–6; co-ordinates 7.9/105.2
Figs 7, 8. Laingipollenites microverrucatus n. fgen. et fsp., slide Vila Flor esc. 2/1–2; co-ordinates 11.6/105.3
Figs 9, 10. Laingipollenites microverrucatus n. fgen. et fsp., slide Vila Flor esc. 3/2–5; co-ordinates 19.1/112.1
Figs 11, 12. Samoilovichaepollenites minor n. fgen. et fsp., slide Vila Flor casa 2/10; co-ordinates 16.7/107.3
Figs 13, 14. Samoilovichaepollenites minor n. fgen. et fsp., slide Vila Flor esc. 3/2–4; co-ordinates 13.6/114.6
Figs 15, 16. Samoilovichaepollenites minor n. fgen. et fsp., slide Vila Flor esc. 2/1–7; co-ordinates 8.4/106.9
Figs 17, 18. Samoilovichaepollenites minor n. fgen. et fsp., slide Vila Flor esc. 3/2–5; co-ordinates 7.9/115.7
Figs 19, 20. Samoilovichaepollenites minor n. fgen. et fsp., slide Vila Flor esc. 2/1–8; co-ordinates 6.7/109.9
Figs 21, 22. Samoilovichaepollenites microreticulatus n. fgen. et fsp., slide Vila Flor esc., 2/1–1; co-ordinates 14.9/109.3
Figs 23, 24. Samoilovichaepollenites concavus n. fgen. et fsp., slide Vila Flor casa 1/17; co-ordinates 9.6/104.7
Figs 25, 26. Samoilovichaepollenites concavus n. fgen. et fsp., slide Vila Flor casa 1–16; co-ordinates 10.1/114.1
Figs 27, 28. Medusipollenites triangulus n. fgen. et fsp., slide Vila Flor esc. 2/1–8; co-ordinates 11.9/107.9. ×1000

Diagnosis

Ambitus triangular, with convex sides, apertural region very prominent. Surface finely verrucate, sometimes rugulate, the diameter of the sculptural elements is about 0.5 μ. The exine is 1.5–2 μ thick. Exoapertures short, about 3–4 μ long colpi, endoapertures small pori. Diameter: 16–24 μ.

Holotype: Plate II, Figs 26, 27, slide Vila Flor esc. 2/1–8, co-ordinates 14.6/111.3.
Locus typicus: Vila Flor (Portugal).
Stratum typicum: carbonaceous clay.
Derivatio nominis: From the characteristic surface ornamentation.
Differential diagnosis: The larger size mainly distinguishes *L. microverrucatus* from the former form-species.
Occurrence: Vila Flor casa-1, Vila Flor esc. 2/1, 2/3, 3/2, 3/3.

6. *Samoilovichaepollenites* **n. fgen.**
Fgen. typus: *Samoilovichaepollenites minor* n. fgen. (Plate III, Figs 11–20).

Diagnosis

Triangular, triaperturate pollen grains. Apertural region more or less prominent. In the apertural region, the exine is thinner than in the extra apertural parts.

Locus typicus: Vila Flor (Portugal).
Stratum typicum: carbonaceous clay.
Derivatio nominis: In honour of Dr. S. R. SAMOILOVICH.
Differential diagnosis: The thinner exine in the apertural region makes this distinct from *Laingipollenites* n. fgen.
Stratigraphical distribution: Cenomanian and Turonian, but based on the data of SAMOILOVICH (1965) possibly up to the Maestrichtian.

1. *Samoilovichaepollenites minor* **n. fsp.** (Plate III, Figs 11–20)

Diagnosis

Ambitus triangular, with convex sides. Surface punctate or scabrate. Exoapertures small, short colpi, endoapertures pori. Exine, in the extra apertural region 2.5 μ thick. The three layers of the ectexine have the same thickness. In the apertural region, the exine is 0.8–1 μ.
Diameter: 13–16 μ.

Holotype: Plate III, Figs 11, 12, slide Vila Flor casa-2/10, co-ordinates 16.7/107.3.
Locus typicus: Vila Flor (Portugal).
Stratum typicum: carbonaceous clay.
Derivatio nominis: From the small size of these pollen grains.
Occurrence: Vila Flor casa-1, 2, 3, Vila Flor esc. 2/1, 2/2, 2/3, 3/2, 3/3.

2. *Samoilovichaepollenites microreticulatus* **n. fsp.** (Plate III, Figs 21, 22)

Diagnosis

Ambitus triangular, with straight or convex sides. Apertural region is somewhat prominent. Surface finely reticulate, the mesh of the sculptural elements is about 0.4 μ. The exoapertures are small colpi about 3–4 μ long. Endoapertures pori. The extra apertural exine is 2 μ; the apertural exine is 1 μ thick.
Diameter: 14–18 μ.

Holotype: Plate III, Figs 21, 22, slide Vila Flor esc. 2/1–1, co-ordinates 14.9/109.3.

Locus typicus: Vila Flor (Portugal).

Stratum typicum: carbonaceous clay.

Derivatio nominis: From the surface ornamentation.

Differential diagnosis: *S. microreticulatus* is distinguishable from *S. minor* n. fsp. on the basis of sculpture. But here SEM investigations are very necessary.

Occurrence: Vila Flor casa-1, Vila Flor esc. 2/1, 3/3.

3. *Samoilovichaepollenites concavus* **n. fsp.** (Plate III, Figs 23–26)

Diagnosis

Ambitus triangular, with concave sides. Aperture region prominent. Surface granular or covered with tiny verrucae. Basal diameter of the sculptural elements is about 0.5 μ. The bases of the sculptural elements form a negative reticulum. The exoapertures are short colpi, the endoapertures pori. The exine, near the apertures is 0.5–0.7 μ, in the extra apertural region approximately 2 μ. The tectum, infratectal layer, and foot layer have the same thickness. Infratectum is columellar.

Diameter: 17–23 μ.

Holotype: Plate III, Figs 23, 24, slide Vila Flor casa 1/17, co-ordinates 9.6/104.7.

Locus typicus: Vila Flor (Portugal).

Stratum typicum: carbonaceous clay.

Derivatio nominis: From the characteristic equatorial outline.

Differential diagnosis: The greater size, the equatorial outline, and the surface ornamentation separate *S. concavus* from the above described new form-species.

Occurrence: Vila Flor casa-1.

7. *Medusipollenites* **n. fgen.**

Fgen. typus: *Medusipollenites triangulus* n. fsp. (Plate III, Figs 27, 28)

Diagnosis

Ambitus triangular, with straight or slightly convex or concave sides. Surface smooth or scabrate. Exoapertures short colpi, endoapertures pori. Around the endoapertures there is a thin inner layer, probably endexine. The ectexine in the apertural region is thinner than in the extragerminal region.

Locus typicus: Vila Flor (Portugal).

Stratum typicum: carbonaceous clay.

Derivatio nominis: In honour of Dr. J. Medus.

Differential diagnosis: The inner, probably endexine layer, around the endopores is distinct from that of other *Probrevaxones*. But on the other hand it seems that this is not so typical within this group and a little intermediate to the primitive Normapolles.

1. *Medusipollenites triangulus* **n. fsp.** (Plate III, Figs 27, 28)

Diagnosis

Ambitus triangular with rounded "angles" and slightly concave sides. Surface smooth or very finely scabrate. Exoapertures small colpi, 3 μ long. The diameter of the endopores is

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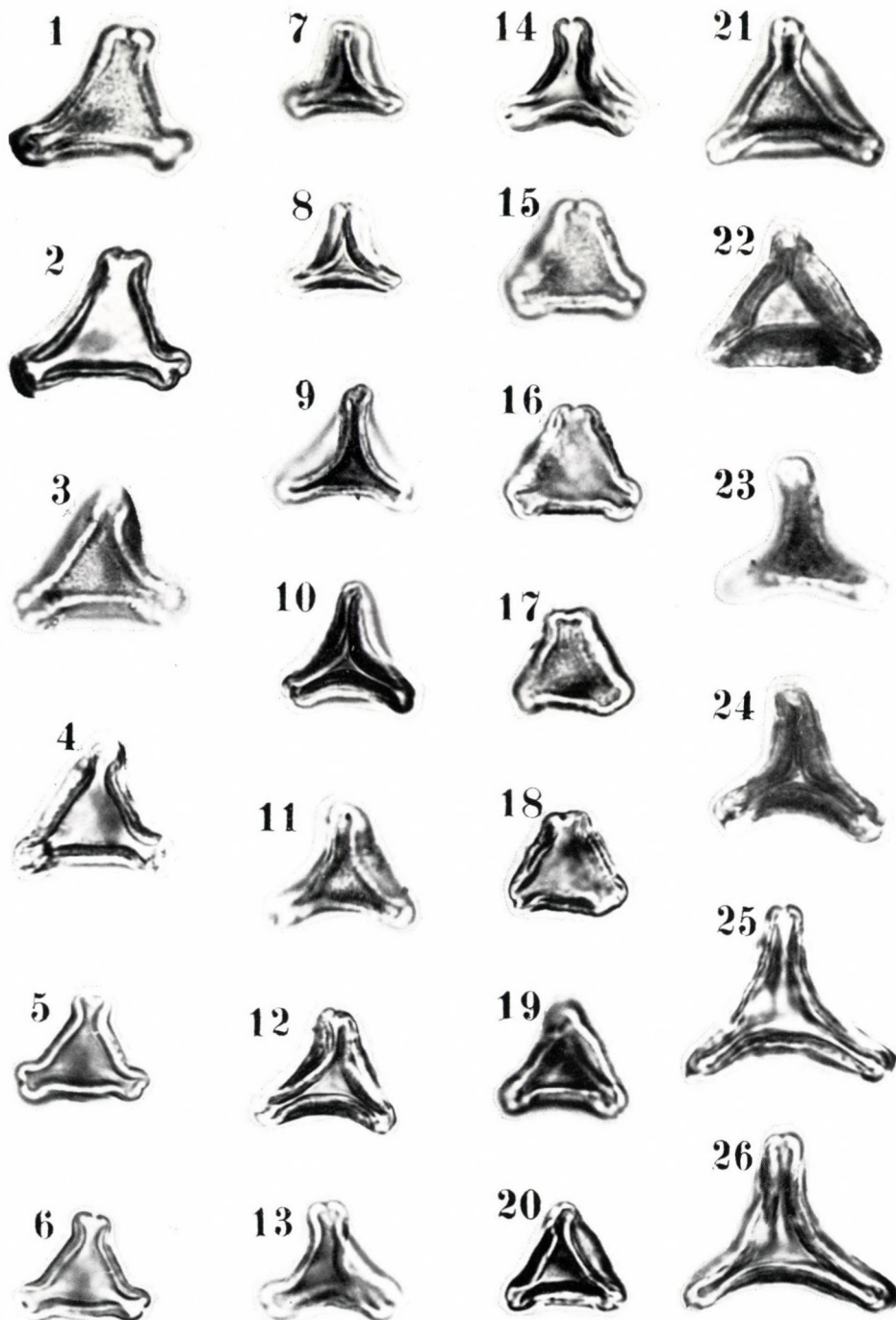
about 1 μ. The exine in the apertural region is 0.5 μ thick, and 2 μ in the extragerminal region. In the extragerminal region the tectum is thicker than the infratectum. The nexine is about as thick as the tectum. The endexine, around the endopores is 1 μ in width.
Diameter: 13–16 μ.

Holotype: Plate III, Figs 27, 28, slide Vila Flor esc. 2/1–8, co-ordinates 11.9/107.9.
Locus typicus, stratum typicum, see above.
Derivatio nominis: From the equatorial outline.
Occurrence: At present from the locality type only.

8. *Vilaflorpollenites* **n. fgen.**
Fgen. typus: *Vilaflorpollenites concavus* n. fsp. (Plate IV, Figs 1–4)

Diagnosis
Triangular, triaperturate pollen. Apertural region prominent. Exoapertures colpi, endoapertures pori. The exine on the sides is thickened, this thickening may be combined with plicae, or pseudoplicae. Surface finely sculptured.

Locus typicus: Vila Flor (Portugal).
Stratum typicum: carbonaceous clay.
Derivatio nominis: From Vila Flor, the type locality.

Remarks. — The term pseudoplicae is used when two plicae are on one surface and the third on another. It seems, that there is a morphological line which is as follows: *Laingipollenites*, *Samoilovichaepollenites*, *Vilaflorpollenites*.

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Plate IV

Figs 1, 2. Vilaflorpollenites concavus n. fgen. et fsp., slide Vila Flor esc. 3/2–6; co-ordinates 10.4/114.1
Figs 3, 4. Vilaflorpollenites concavus n. fgen. et fsp., slide Vila Flor esc. 2/1–8; co-ordinates 13.8/104.4
Figs 5, 6. Vilaflorpollenites laevigatus n. fgen. et fsp., slide Vila Flor casa 1/5; co-ordinates 9.2/110.2
Figs 7, 8. Vilaflorpollenites laevigatus n. fgen. et fsp., slide Vila Flor esc. 3/2–8; co-ordinates 8.3/109.6
Figs 9, 10. Vilaflorpollenites crassiexinus n. fgen. et fsp., slide Vila Flor casa 3/1; co-ordinates 18.3/105.5
Figs 11, 12. Vilaflorpollenites crassiexinus n. fgen. et fsp., slide Vila Flor esc. 2/1–7; co-ordinates 16.2/115.3
Figs 13, 14. Vilaflorpollenites minor n. fgen. et fsp., slide Vila Flor casa 1/11; co-ordinates 14.7/115.3
Figs 15, 16. Vilaflorpollenites minor n. fgen. et fsp., slide Vila Flor esc. 3/2–8; co-ordinates 19.3/115.2
Figs 17, 18. *Vilaflorpollenites ibericus* n. fgen. et fsp., slide Vila Flor esc. 3/2–5; co-ordinates 11.7/104.9
Figs 19, 20. Vilaflorpollenites ibericus n. fgen. et fsp., slide Vila Flor esc. 3/3–6; co-ordinates 10.6/105.3
Figs 21, 22. Vilaflorpollenites pflugii n. fgen. et fsp., slide Vila Flor casa 1/23; co-ordinates 19.8/105.7
Figs 23, 24. Vilaflorpollenites rugulatus n. fgen. et fsp., slide Vila Flor esc. 3/3–8; co-ordinates 17.9/115.3
Figs 25, 26. Vilaflorpollenites magnus n. fgen. et fsp., slide Vila Flor casa 2/3; co-ordinates 16.2/106.4. ×1000

In the *Vilaflorpollenites* another morphological line may be established, which may be a basis of further reclassification. At present we do not have enough information to solve this question. Moreower SEM and TEM data are also necessary for the final evaluation of these forms.
Differential diagnosis: STELMAK (1961) described *Santalacites santaloides* STELMAK gen. et sp. nov., without a generic and differential diagnosis, and therefore it is not valid. *Gothanipollis* W. KR. 1959a is syncolpate with tiny air sacs. The geological age of *Gothanipollis* is distinctive also. It is noteworthy that ZAKLINSKAIA (1963) classed many forms in this form-genus, and used *Gothanipollis* for Cenomanian and Turonian pollen also. PONOMARENKO (1966), SKURATENKO (1966) and KOMAROVA (1973) accepted STELMAK's (1961) taxonomy.

Stratigraphical distribution: Upper Cenomanian to Turonian.

1. *Vilaflorpollenites concavus* **n. fsp.** (Plate IV, Figs 1–4)

Diagnosis

Ambitus triangular, with concave sides. Surface granulate or covered with small flat verrucae or rugulae, with bases about 0.6 μ in diameter. The diameter of the sculptural elements sometimes form a negative reticulum. The colpi are 3–4 μ long, and the pore diameter is about 0.5 μ. Around the germinaliae, the exine is 0.8 μ thick, on the sides 2–2.5 μ. Plicae may be present.
Diameter: 14–22 μ.

Holotype: Plate IV, Figs 1, 2, slide Vila Flor esc. 3/3–6, co-ordinates 10.4/114.1
Locus typicus and stratum typicum, see above.
Derivatio nominis: From the equatorial contour.
Occurrence: Vila Flor casa-1, Vila Flor esc. 2/1, 2/3, 3/2.

2. *Vilaflorpollenites laevigatus* **n. fsp.** (Plate IV, Figs 5–8)

Diagnosis

Ambitus triangular, with concave sides. Surface smooth. The colpi are 2–3 μ long, the diameter of the exo- and endoapertures is about 0.5 μ. The exine is 0.5 μ thick in the apertural area and 2.5–3 μ in the extragerminal region. No plicae.
Diameter: 12–18 μ.

Holotype: Plate IV, Figs 5, 6, slide Vila Flor casa 1/5, co-ordinates 9.2/110.2.
Locus typicus: Vila Flor (Portugal).
Stratum typicum: carbonaceous clay.
Derivatio nominis: From the smooth surface.
Differential diagnosis: The smaller size, and the smooth surface separate *V. laevigatus* from *V. concavus* n. fsp.
Occurrence: Vila Flor casa-1, 2 Vila Flor esc. 2/1, 3/2.

3. *Vilaflorpollenites crassiexinus* **n. fsp.** (Plate IV, Figs 9–12)

Diagnosis

Ambitus triangular with slightly convex or concave sides. Surface finely sculptured. The sculptural elements are flat verrucae or tiny rugulae. The size of these elements is about 0.5–1 μ. The exoapertures are 2–3 μ long colpi. The endoapertures are pori about 0.5 μ in diameter. The exine is 2–3 μ thick on the sides, 1.5 μ near the apertures. Generally no plicae.
Diameter: 13–17 μ.

Holotype: Plate IV, Figs 9, 10, slide Vila Flor casa 3/1, co-ordinates 18.3/105.5.
Locus typicus: Vila Flor (Portugal).
Stratum typicum: carbonaceous clay.
Derivatio nominis: From the relatively thick exine on the sides.
Differential diagnosis: The sculpture and the relatively thick lateral exine easily distinguish this species from *V. laevigatus* n. fsp.
Occurrence: Vila Flor casa-1, 2, 3, Vila Flor esc. 2/1, 2/3, 3/2, 3/3.

4. *Vilaflorpollenites minor* **n. fsp.** (Plate IV, Figs 13–16)

Diagnosis

Equatorial outline triangular, with straight, convex or concave sides. Surface smooth or very finely scabrate. The exoapertures are very short, and the endopori very tiny. The exine is relatively thin (0.5 μ) in the germinal area and 1 μ in the extragerminal region. There are very characteristic plicae or pseudoplicae.
Diameter: 12—14μ.

Holotype: Plate IV, Figs 13, 14, slide Vila Flor casa 1/11, co-ordinates 14.7/115.3.
Locus typicus: Vila Flor (Portugal).
Stratum typicum: carbonaceous clay.
Derivatio nominis: From the relatively small size.
Differential diagnosis: The smaller size and the characteristic plicae or pseudoplicae make this species distinct from *V. laevigatus* n. fsp.
Occurrence: Vila Flor casa-1, 2, 3, Vila Flor esc. 2/1, 2/2, 2/3, 3/2.

5. *Vilaflorpollenites ibericus* **n. fsp.** (Plate IV, Figs 17–20)

Diagnosis

Equatorial outline triangular, generally with concave sides. Surface covered with granules 0.5 μ in size. Exoapertures short narrow colpi about 2 μ long, endoapertures tiny, 0.3 μ pori. There are very characteristic, prominent plicae. Sometimes pseudoplicae may be present. The exine thickening on the sides is not so characteristic, but the exine in the apertural region is thinner than on the sides. Exine thickness on the sides is 1 μ and 0.6 μ in the apertural region.
Diameter: 14–18 μ.

Holotype: Plate IV, Figs 17, 18, slide Vila Flor esc. 3/2–5, co-ordinates 11.7/104.9.
Locus typicus: Vila Flor (Portugal).
Stratum typicum: carbonaceous clay.
Derivatio nominis: From the Iberian Peninsule.
Differential diagnosis: The greater size and the surface ornamentation separates *V. ibericus* from *V. minor* n. fsp.
Occurrence: Vila Flor casa-1, 2, Vila Flor esc. 2/1, 2/2, 3/2, 3/3.

6. *Vilaflorpollenites pflugii* **n. fsp.** (Plate IV, Figs 21, 22)

Diagnosis

Ambitus triangular, generally with straight sides. Surface granular, or finely verrucate, with the size of the sculptural elements being 0.3–0.5 μ. There are very characteristic prominent plicae. The wall is 2–2.5 μ thick on the sides. The external layer (tectum) is thicker than the internal layers. In the germinal region the exine is 1–1.5 μ thick. Exoaperture long colpi, endoapertures tiny pori.
Diameter: 18–22 μ.

Holotype: Plate IV, Figs 21, 22, slide Vila Flor casa 1/23, co-ordinates 19.8/105.7.
Locus typicus: Vila Flor (Portugal).
Stratum typicum: carbonaceous clay.
Derivatio nominis: In honour of Prof. H. D. PFLUG.
Differential diagnosis: The very characteristic plicae and the relatively thick lateral exine distinguish *V. pflugii* from *V. ibericus* n. fsp.
Occurrence: To date from the locality type only.

7. *Vilaflorpollenites rugulatus* **n. fsp.** (Plate IV, Figs 23, 24)

Diagnosis

Ambitus concave with extremely concave sides. Plicae very prominent, and double layered. Surface rugulate with the basal diameter of the sculptural elements being 1–2.5 μ. The exine is relatively thick and sometimes there is a very fine exine thickening around the exoapertures. No vestibulum or endexine originated endannulus. Exoapertures colpi, endoapertures pori.
Diameter: 14–20 μ.

Holotype: Plate IV, Figs 23, 24, slide Vila Flor esc. 3/3–8, co-ordinates 17.9/115.3.
Locus typicus: Vila Flor (Portugal).
Stratum typicum: carbonaceous clay.
Derivatio nominis: From the surface ornamentation.
Differential diagnosis: The characteristic outline and the surface ornamentation separate *V. rugulatus* from *V. ibericus*.

Remark. — This is not a completely typical species of this form-genus. There is a superficial resemblance to the *Complexiopollis* form-genus but as we have pointed out there is no vestibulum, or endexine which are characteristic of this form-genus. A new study concerning the *Complexiopollis* linegae will be completed before long.
Occurrence: Vila Flor esc. 3/2, 3/3.

8. *Vilaflorpollenites magnus* **n. fsp.** (Plate IV, Figs 25, 26)

Diagnosis

Equatorial outline triangular, with extremely concave sides. Surface finely granulate. Well developed prominent plicae. The exine is a little thicker on the sides than in the apertural region 1–1.5 μ. The exoapertures tiny pori.
Diameter: 18–24 μ.

Holotype: Plate IV, Figs 25, 26, slide Vila Flor casa 2/3, co-ordinates 16.2/106.4.
Locus typicus: Vila Flor (Portugal).
Stratum typicum: carbonaceous clay.
Derivatio nominis: From the relatively large size compared to other members of form-genus.
Differential diagnosis: The great size, and the extremely concave outline separate *V. magnus* from the other species of this form-genus.
Occurrence: Vila Flor casa-1, 2.

Discussion and conclusions

The described new taxa and the discovery of the intermediate character of these pollen types among *Longaxones* (tricolporates) and *Normapolles* provide new possibilities for solving the evolutionary problems of the Angiospermatophyte pollen.

1. It was not a "genetical explosion" (strong mutation) which gave rise to the *Normapolles*. Until, this time, the *Complexiopollis* fgen. has been considered to be the earliest *Brevaxones Normapolles* (TSCHUDY 1973). Now, the *Normapolles* may be easily derived from the *Probrevaxones*. A morphological evolutionary scheme for the early *Brevaxones* will be completed before long, and the details will be discussed in a forthcoming paper.

2. Regarding the distribution of the *Probrevaxones*, it may be shown, that they occur not only in the *Normapolles* region, but in the intermediate areas as well. They are also present in South America. This fact and the morphological characteristic features of the *Vilaflorpollenites* particularly *V. ibericus*, show some similarities to Loranthaceous pollen grains. It is noteworthy that the Loranthaceous relationship may solve the *Normapolles–Aquilapollenites* problem.

3. Morphologically in the evolution, the first stage was the shortening of the polar axis, and in parallel the colpi become shorter. The most primitive *Probrevaxones* is *Bolchovitinaepollenites*. This form-genus may be derived from different tricolporate types: *Psilatricolporites*, *Scabratricolporites*, *Retitricolporites*, etc. The most advanced form-genus is *Vilaflorpollenites*, which, is without doubt heterogenous. It will be reassessed later, but for a more detailed classification we need further information.

ACKNOWLEDGEMENTS

The writers are deeply indebted to Dr. WARREN S. DRUGG (Chevron Oil Field Research Company, La Habra, California, USA) for critically reading the manuscript with respect to linguistic errors.

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Acta Botanica Academiae Scientiarum Hungaricae, Vol. 27 (3–4), pp. 403–419 (1981)

LIGHT MICROSCOPE STUDIES ON THE OIL BODIES OF CUBAN LIVERWORTS, I

By

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(Received: April 15, 1981)

Descriptions and pictures of the oil bodies of 26 liverwort species collected in Cuba are submitted. Among the oil body records of 19 species published for the first time the data on *Anomoclada*, *Bonneria* = *Leucosarmentum*, *Micropterygium* and *Symphyogyna* are new at the generic level. Literature records on the concerned taxa are given together with some taxonomic conclusions drawn from the new oil body observations.

Oil body studies on tropical and on subtropical liverworts, if we do not count early, scattered data (e.g. of SCHIFFNER 1913), started relatively late, due to the difficulties of obtaining tropical materials alive. The papers of JOVET-AST (1948, 1949), were the first of that kind, contributing data on the oil bodies of 5 central African and of 4 Caribbean liverworts. Then HATTORI (1951, 1953) described the oil bodies of many Japanese *Hepaticae*, followed by a joint paper (SCHUSTER–HATTORI 1954), which dealt with the oil bodies from different parts of the World. ARNELL's handbook on South African *Hepaticae* (1963) deals with many African species, practically indicating the time, when comprehensive tropical liverwort revisions start to incorporate and use data on oil bodies for taxonomic purposes (e.g. MEYER 1959, INOUE–SCHUSTER 1971, GRADSTEIN 1975, JONES 1976).

In the meantime INOUE described and depicted in his papers and books the oil bodies of a large number of Asian liverworts (1964, 1967, 1974, 1976, 1979), and GRADSTEIN, CLEEF and FULFORD (1977) gave an account on some Colombian species. Since the paper of HATTORI and SCHUSTER (1954) these are the first detailed data on the oil bodies of Latin American *Hepaticae*, if we do not mention SCHUSTER's books (1966, 1969, 1974), which contain data for many species occurring in the southeastern United States.

During the preparation of the Hepatic Flora of Cuba, we felt the necessity to investigate oil body morphology of the taxonomically reviewed species. During his last study trip connected to the Flora works, T. PÓCS together with his Cuban colleagues, first of all with D. REYES M. collected large number of liverworts for oil body studies. One part of the materials was drawn by T. PÓCS right after their collection or a few days later, in which case were

kept dark and cool in refrigerator. An other part, brought to Hungary, was then photographed by G. KIS and the whole material was compared by both of us with the available literature data. In this first paper of a proposed series we would like to publish about one third of our data accumulated till now on the oil bodies of Cuban liverworts. We try to continue our studies, involving other colleagues too.

In the coming enumeration we use the classification of oil body types given by GRADSTEIN, CLEEF and FULFORD (1977). It is necessary to mention, that at least one more type, the *Radula* type of MÜLLER exists, to which we could incorporate members of several other genera too. We give the localities and habitat data, the name of collector and identifier along the description and pictures of oil body types. One vaucher specimen of each is deposited in HAC and in EGR and some of the samples are kept alive in non sterile culture by S. PÓCS. The investigations were made in the Botanical Institute of Cuban Academy of Sciences (Habana-Santiago) and in the Botanical Institute of the Hungarian Academy of Sciences (Vácrátót).

The enumeration follows the genus sequence given by SCHUSTER (1979). The specimens discussed in this first instalment were identified by T. PÓCS, and by J. VÁŇA. Before the name of species one asterisk means the first oil body record for the species, two asterisks mean the first record from the genus concerned. The magnification of all figures is approximately 800 : 1.

1. ***Herbertus divergens*** (STEPH.) HERZ. (Fig. 18)

Oil bodies *Bazzania* type, 40–60 per vitta cells, ovoid in shape, simple or segmented, when usually one large segment is accompanied by 1–2 smaller on the apexes. The same type is observed by HATTORI (1951) in *Herbertus sakuraii* and in *H. longifissus*, although by the first he has found more segmented types too (might be due to the degeneration of cells).

Sierra de la Gran Piedra, montane rain forest reserve behind Finca Isabelica, on palm stem, at 1100 m alt. Coll. T. PÓCS and M. CALUFF, 9199/DE, 1. Nov. 1980, det. T. PÓCS.

2. ***Herbertus juniperioideus*** (Sw.) GROLLE (Figs. 1, 19 and 20)

Oil bodies as by the above species, but usually more densely and higher in number per cells and their shape is more variable. Oil bodies of the related *H. aduncus* are described by SCHUSTER (1966: 713, Fig. 71/1, 9), as glistening, nearly homogenous, of faint, minute sphaerules. *Herbertus limbatus* and *H. oblongifolius* from the Andes have similarly, faintly-granulose papillose oil bodies, as *H. aduncus*, so the *Jungermannia* type oil body seems to be more common by *Herbertus*, than the *Bazzania* type. The oil body character seems to be a good distinction between *Herbertus aduncus* and *H. juniperoideus*. Sierra de la Gran Piedra, Subida de las Rosas, on relatively dry granitic rocks at 1100 m alt. Coll. T. PÓCS and M. CALUFF 9205/K, 1. Nov. 1980. Det. T. PÓCS.

In one other specimen we observed disc shaped oil bodies, round or with 1–2 irregular bulges.

In the time of first observation (Figs 1 and 20) they were not true *Bazzania* type, because not homogeneous. Within a greyish stroma more transparent oil vesicles were observable, similarly to some *Lophozia* species (cf. MÜLLER 1939, PIHAKASKI 1968). Their number is much less, than that of the above specimen, and their mass does not occupy the whole cell lumen.
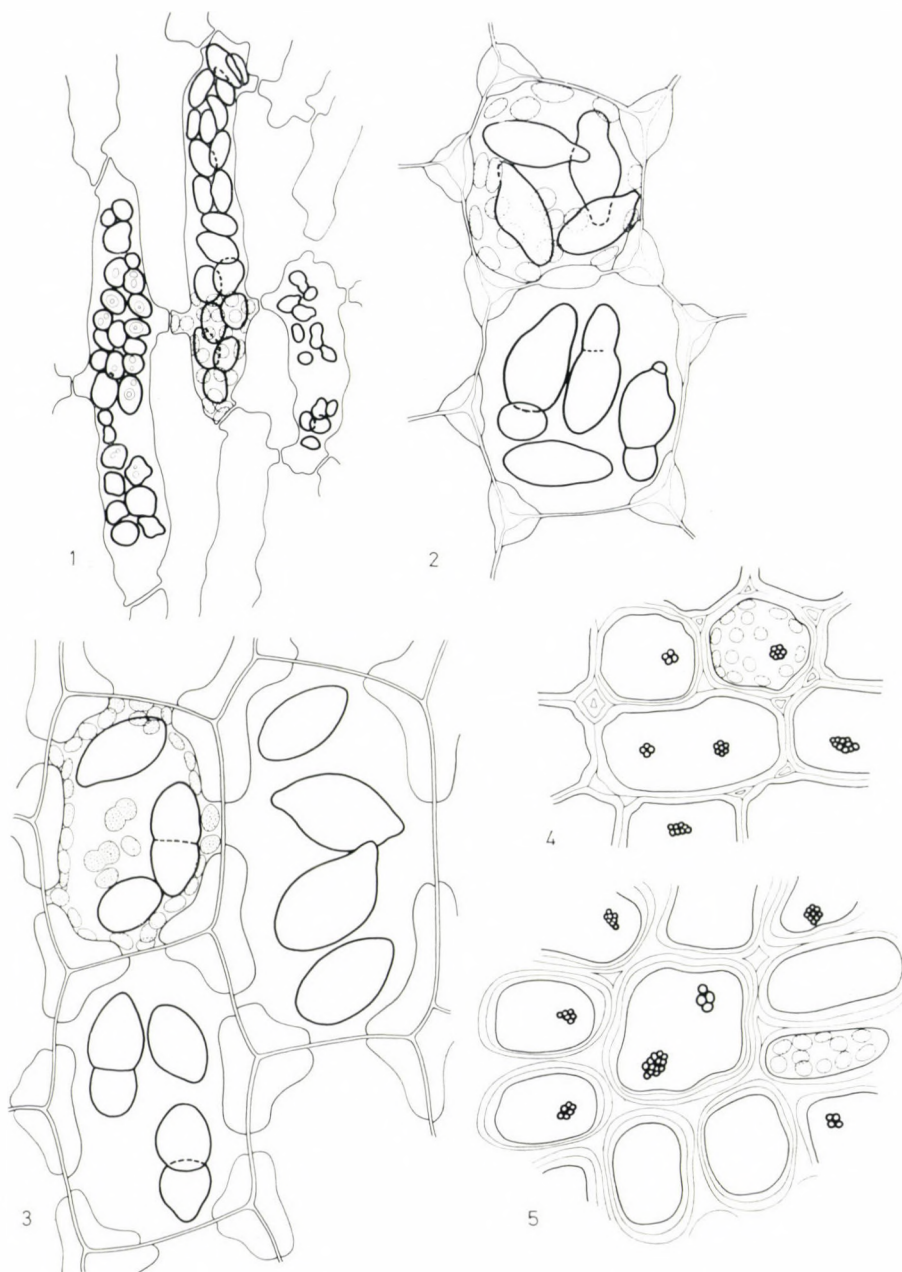
Fig. 1. Vitta cells of *Herbertus juniperoideus* (Sw.) Grolle with abnormal oil bodies. No. 9170/J
Fig. 2. Median leaf cells of *Bazzania armatistipula* (STEPH.) FULF. 9170/R
Fig. 3. Median leaf cells of *Bazzania bidens* (NEES) TREV. 9170/Q
Fig. 4. Median leaf cells of *Micropterygium carinatum* (GREV.) REIMERS 9175/S
Fig. 5. Median leaf cells of *Micropterygium trachyphyllum* REIMERS 9175/AF
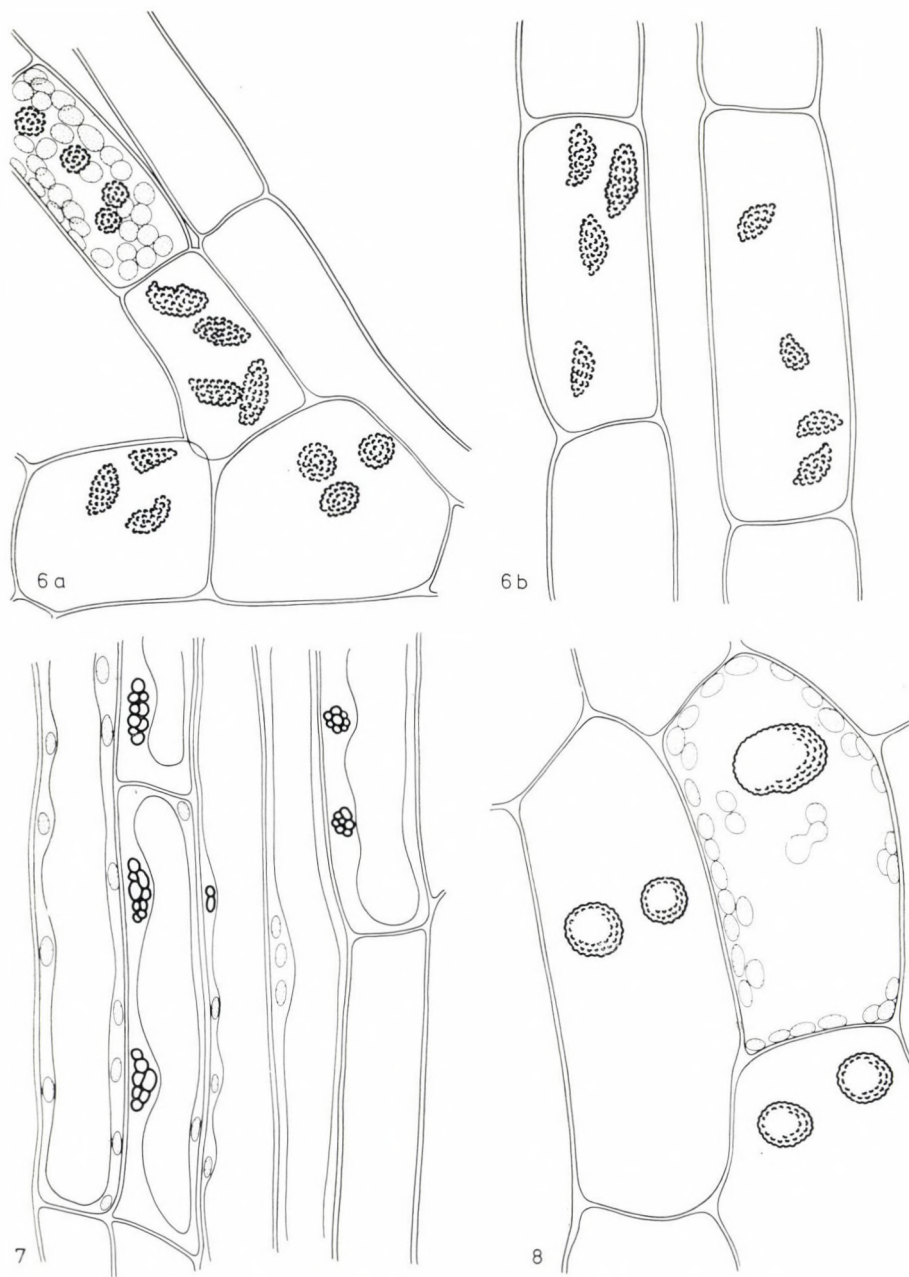
Fig. 6. Leaf segments of *Telaranea nematodes* (Gott. ex Aust.) Howe 9207/F
Fig. 7. Stem medullary cells of *Bonneria bifida* (Steph.) Schust. 9202/C
Fig. 8. Median leaf cells of *Alobiellopsis dominicensis* (Spr.) Fulf. 9202/A
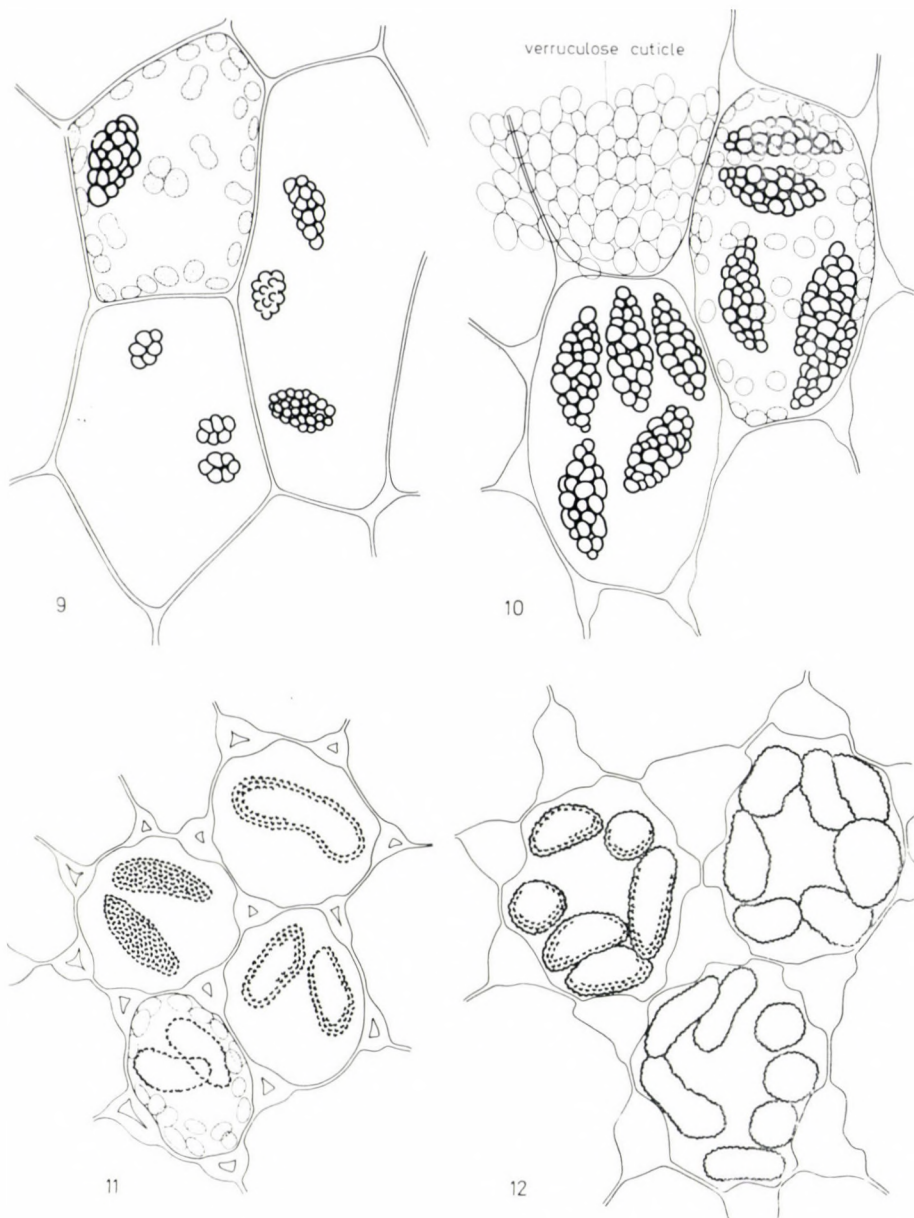
Fig. 9. Median leaf cells of *Calypogeia laxa* Gott. et Lindenb. 9200/Q
Fig. 10. Median leaf cells of *Calypogeia venezuelana* Fulf. 9170/S
Fig. 11. Median leaf cells of *Odontoschisma denudatum* (Mart.) Dum. 9177/Y
Fig. 12. Median leaf cells of *Odontoschisma longiflorum* (Tayl.) Steph. 9173/P
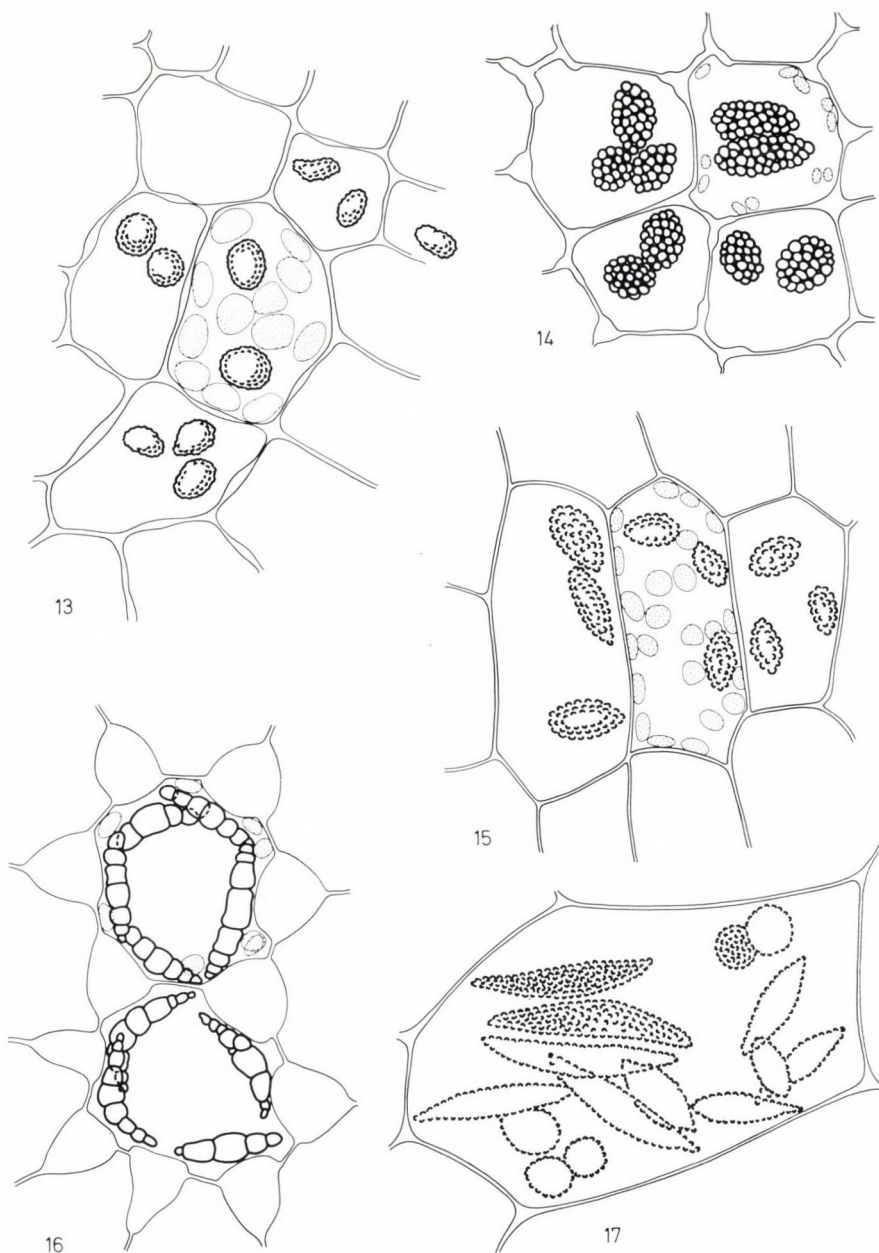
Fig. 13. Median leaf cells of *Cephaloziella antillana* (SPR.) FULF. 9202/D
Fig. 14. Median leaf cells of *Anomoclada mucosa* SPR. 9170/BH
Fig. 15. Lophocolea coadunata (SW.) NEES 9189/S
Fig. 16. Median leaf cells of *Leptoscyphus ovatus* (SPR.) GROLLE 9208/L
Fig. 17. Lower thallus layer of *Symphyogyna digitisquama* STEPH. 9175/K

These curious oil bodies maybe were in a disintegrating stage which caused their abnormity. In a 15 months old culture the same specimen had oil bodies similar to the above discussed Bazzania type again.

Cuchillas de Moa, 2 km N of La Melba, microphyllous serpentine forest by the cascades "Dos Comadres" at 400 m alt. on different substrates. Coll. T. Pócs and D. Reyes M. 9170/J, 10. Oct. 1980, det. T. Pócs.

3. **Kurzia verrucosa** (Steph.) Grolle

We did not find oil bodies in this species, similarly to Gradstein et al. (1977: 401), although Schuster (1969: 42, 58) remarks, that by some species of the genus oil bodies seldom occur, mostly in the medullary cells of the stem and in the basal cells of younger leaves.

Cuchillas de Moa, NW slope of Pico El Toldo. Terricolous in mossy montane rain forest at 900–1000 m alt. Coll. T. Pócs 9176/V, 12. Oct. 1980, det. T. Pócs.

4. **Telaranea nematodes** (Gott. ex Aust.) Howe (Figs 6a, b, 21a, b)

Our observation agrees quite well with those of Gradstein, Cleef and Fulford (1977: 416). Cuban *Telaranea nematodes* has sphaeric or lemon shaped oil bodies, composed of fine or medium sized granules. They belong to the finely botryoidal *Jungermannia* type. 2–4 occurred per leaf segment cells. Records on *Telaranea neesii* (Inoue 1967: 55, 1979: 27) refer to similar, more fusiform oil body type, while *T. trisetosa* has globose-ellipsoid oil bodies, also composed of many sphaerules (Inoue 1979: 27, Pl. 6A).

Sierra de la Gran Piedra, W slope of Pico Kentucky (Figs 6a, b) and Valley of Rio Indio (Figs 21a, b). Both localities in montane rain forest at 1050 m, on bark and on rotten tree fern stem. Coll. T. Pócs, D. Reyes M. and M. Caluff No. 9207/F and T. Pócs M. Caluff 9206/AB, 1–2. Nov. 1980, det. T. Pócs.

5. ***Bazzania armatistipula** (Steph.) Fulf. (Figs 2, 22, 23)

Oil bodies characteristically of *Bazzania* type, large, 2–4 per cell, ellipsoid or ovate, simple or compound of 2–3 equal or unequal segments. Equal segments often form pairs.

Fig. 2: Cuchillas de Moa, 2 km N of La Melba, on rotting wood near the cascades "Dos Comadres" at 400 m alt. Coll. T. Pócs and D. Reyes M. 9170/R, 10. Oct. 1980, det. T. Pócs.

Figs 22–23: Sierra de la Gran Piedra, montane rain forest reserve behind Finca Isabelica, on palm base and trunk, at 1100 m alt. Coll. T. Pócs and M. Caluff 9199/J, DG, 1. Nov. 1980, det. T. Pócs.

6. ***Bazzania bidens** (Nees) Trev. (Figs 3, 24)

Oil bodies of *Bazzania* type, large, 2–4 per cell, ellipsoid or lemon shaped, seldom globose. Often simple, sometimes in pairs or with 1–2 small globule at the ends of the main segment, more rarely compound of 4–5 segments.

Locality as same as by the above species, Fig. 2, on bark. Coll. T. Pócs and D. Reyes M. 9170/Q, det. T. Pócs.

7. ***Bazzania stolonifera** (Sw.) Trev. (Fig. 25)

Oil bodies of *Bazzania* type, mostly simple, rarely paired or from 2–3 unequal segments, ovoid or globose in shape. Locality as by 1. *Herbertus divergens*, on bark, No. 9199/BF, det. T. Pócs.

8. ***Zoopsis antillana** Steph.

We did not find oil bodies in this species, which seems to confirm the view of Schuster (1966: 214), that within *Lepidoziaceae* the oil bodies are present in the more archaic genera and lack in the advanced ones. At the other hand, Inoue (1976: 176, 3, f. 3,7 and 1979: 29, f. 6/C, D) reports two different types of oil bodies by *Zoopsis liukiuensis*.

Cuchillas de Moa, NE slope of Mt. Revuelto de los Chinos, on the serpentine soil of evergreen bush, at 850–980 m alt. Coll. et det. T. Pócs, 9175/C, 12. Oct. 1980.
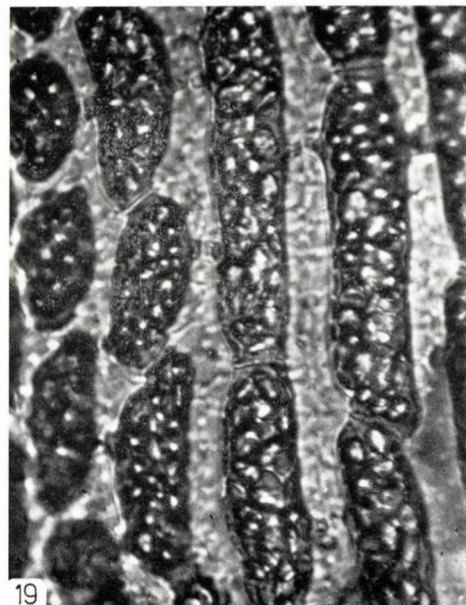
Fig. 18. Basal vitta cells of *Herbertus divergens* (STEPH.) HERZ. 9199/DE
Fig. 19. Basal vitta cells of *Herbertus juniperoideus* (SW.) GROLLE 9205/K
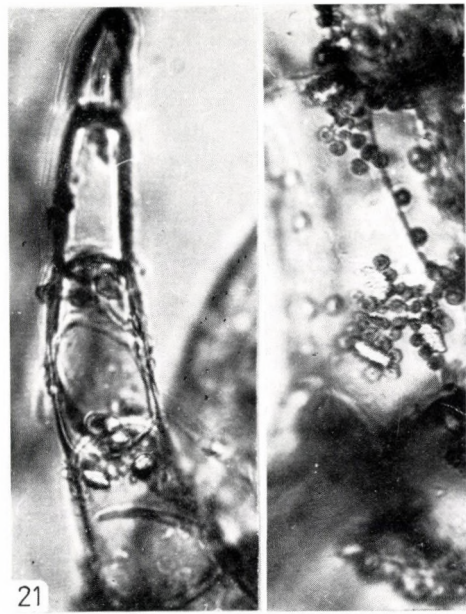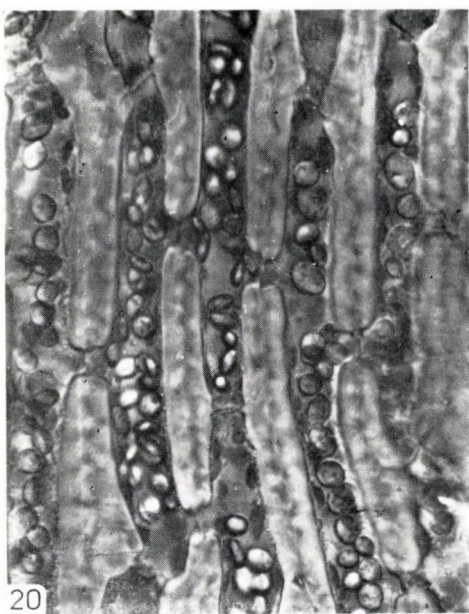
Fig. 20. Basal vitta cells of *Herbertus juniperoideus* (Sw.) Grolle with abnormal oil bodies. 9170/J
Fig 21. Leaf segment cells of *Telaranea nematodes* (GOTT. ex AUST.) HOWE left: segment apex cells; right: leaf base. 9206/AB
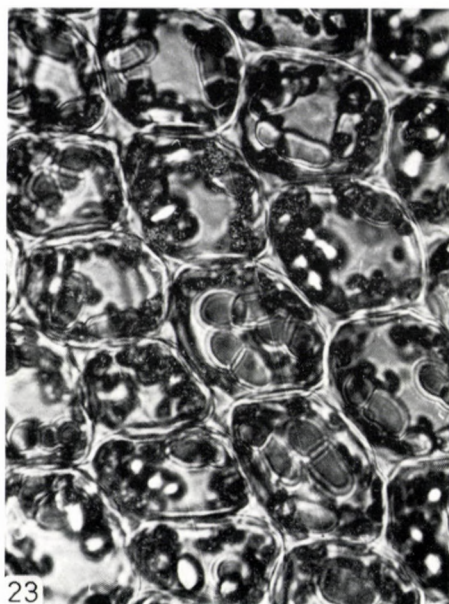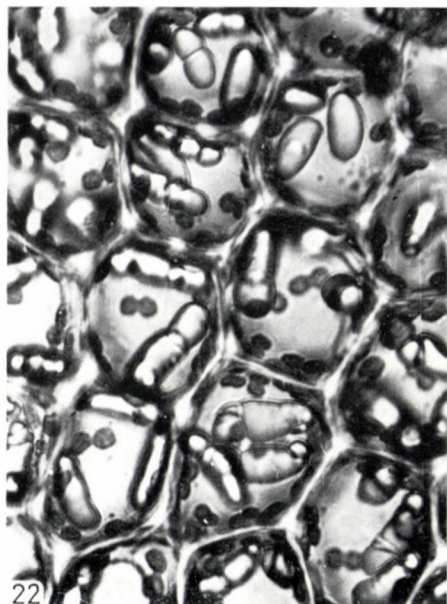
Fig. 22. Median leaf cells of *Bazzania armatistipula* (STEPH.) FULF. 9199/J
Fig. 23. The same, as 22, coll. No. 9199/DG
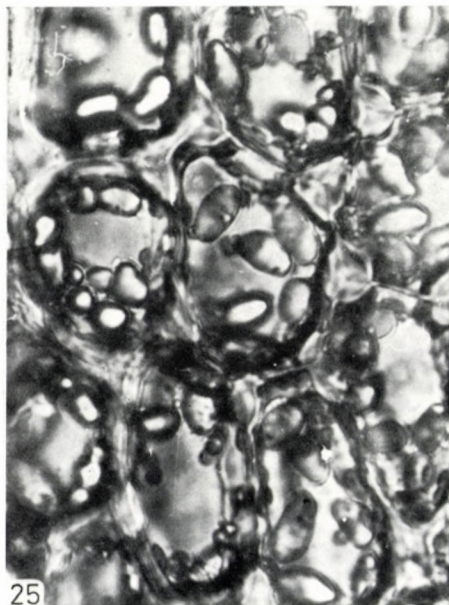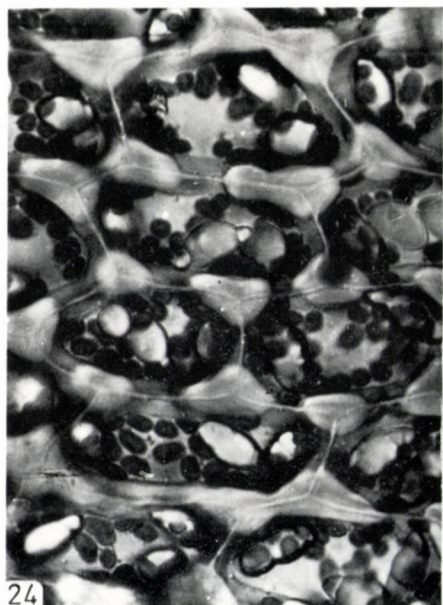
Fig. 24. Median leaf cells of *Bazzania bidens* (NEES) TREV. 9170/Q
Fig. 25. Median leaf cells of *Bazzania stolonifera* (SW.) TREV. 9199/BF
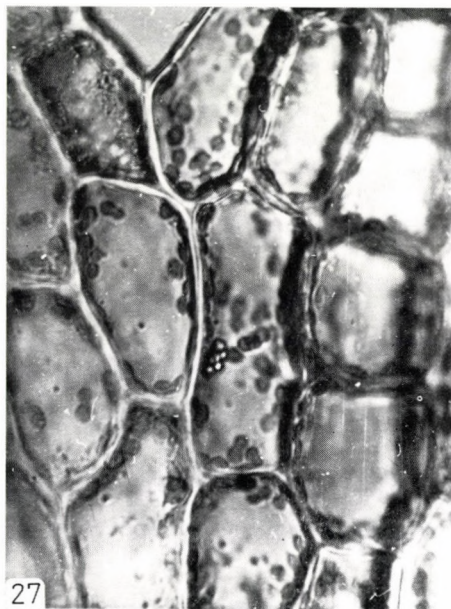
Fig. 26. Leaf base cells of *Bonneria bifida* (STEPH.) SCHUST. 9197/A
Fig. 27. Median leaf cells of *Bonneria bifida* (STEPH.) SCHUST. 9199/AZ
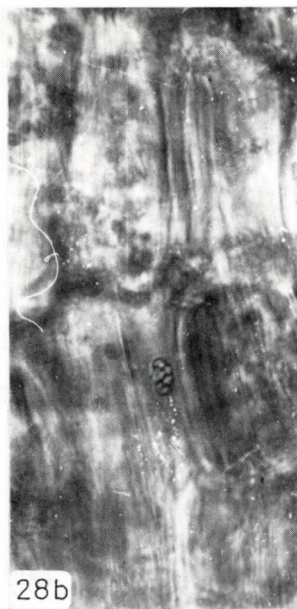
Fig. 28a. The same as Fig. 27
Fig. 28b. Stem medullary cells of the same
Fig. 29. Stem medullary cells of *Bonneria bifida* (STEPH.) SCHUST. 9197/A
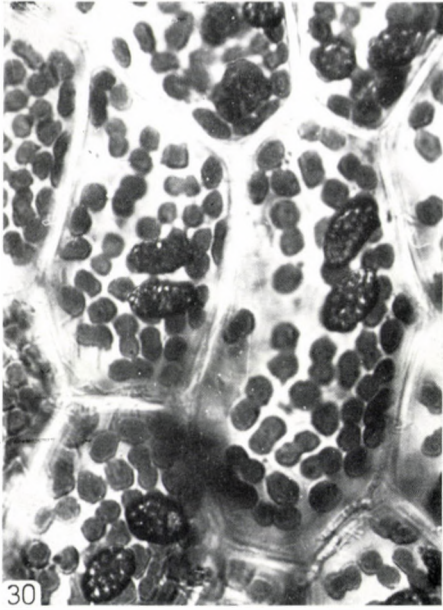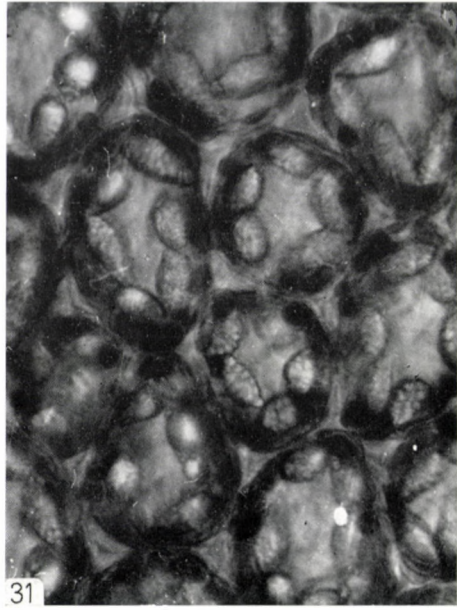
Fig. 30. Median leaf cells of *Calypogeia peruviana* NEES et MONT. 9199/AC
Fig. 31. Median leaf cells of *Calypogeia venezuelana* FULF. 9170/S
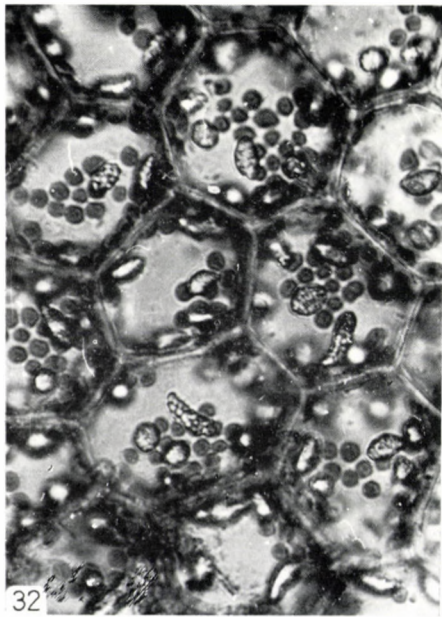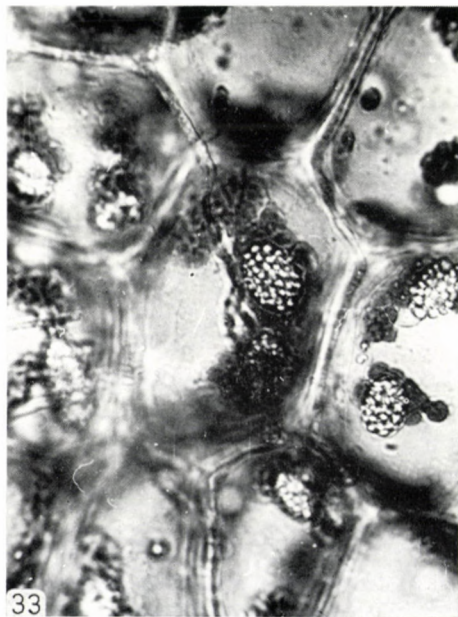
Fig. 32. Median leaf cells of *Lophocolea martiana* NEES 9190/P
Fig. 33. Median leaf cells of *Heteroscyphus combinatus* (NEES) SCHIFFN. 9199/EJ

9. ****Bonneria bifida** (STEPH.) SCHUSTER (Figs 7, 26–29)

Syn.: *Alobiella bifida* STEPH., *Leucosarmentum bifidum* (STEPH.) FULFORD, *Leucosarmentum portoricense* FULFORD.

Oil bodies of *Calypogeia* type, 0–2 per cell, small botryoidal, composed of 2–20 sphaerules, similar in appearence to those of *Micropterygium.* In more light and sun exposed populations their presence is restricted to the medullary stem cells (Fig. 7). Probably environmental factors caused, why GRADSTEIN et al. (1977: 405) did not find oil bodies in this species occurring in the Colombian Cordilleras.

In shady habitats anyway, oil bodies occur throughout the Cuban plant and the oil bodies in the leaves (Figs 26–28a) are not different from those of the stem medullary cells (Figs 28b–29) although do not occur in all cells. Their similarity with the oil bodies in some *Lepidozia* and with those of *Micropterygium* clearly show the close affinity of *Bonneria* to the rest of *Lepidoziaceae.*

Figs 7 and 27–28: Sierra de la Gran Piedra, stony and clayey roadcut surface behind Finca Isabelica, at 1100 m altitude, coll. et det. T. PÓCS 9202/C, 9199/AZ, 30–31 Oct. 1980.

Figs 26, 29: Sierra de la Gran Piedra, Subida de las Rosas (La Siberia), on earthy roadcut surface, at 1100 m alt., coll. and det. by T. PÓCS 9197/A, 29. Oct. 1980.

10. ****Micropterygium carinatum** (GREV.) REIMERS (Fig. 4) and

11. ****Micropterygium trachyphyllum** REIMERS (Fig. 5)

The oil bodies in this Latin-American genus were not known before. They are of *Calypogeia* type in both species, small botryoidal in shape, 0–2 per cell, that is they do not occur in all leaf cells. The oil bodies are composed either of a few larger or of many smaller globules. In the first case a tetraedral arrangement is often at hand. In general appearance they remind first of all of the oil bodies of *Leucosarmentum bifidum*, and to some *Lepidozia* species, e.g. of *Lepidozia vitrea* depicted by HATTORI (1951: 73, f. III/21–24) or of *L. ferdinandi-muelleri* described by INOUE (1979: 23, f. III/D) from New Guinea, especially of *L. macrocolea*, discussed and figured by GRADSTEIN et al. (1977: 402, f. 20). These similarities suggest a close affinity between the subfamilies of *Lepidozioideae, Zoopsidoideae* and *Micropterygioideae* within the family of *Lepidoziaceae.*

Both species were collected at the same locality, together with the above No. 8: *Zoopsis antillana*, on the soil, also identified by T. PÓCS, No. 9175/S and 9175/AF, respectively.

12. ***Calypogeia laxa** GOTT. et LINDENB. in G., L. et N. (Fig. 9)

Oil bodies of *Calypogeia* type, 1–5 per cell, quite irregular and unequal shaped, from few to many globules. There are many records on temperate, subtropical and of tropical *Calypogeia* oil bodies. They all agree concerning the botryoidal type and general appearance, but differ in shape, colour and transparency. The simplest, smallest *Calypogeia* oil bodies are composed only of 1–4 globules and their size is much smaller than that of the cell, reaching only its 1/10–1/5 in length (e.g. that of *C. sphagnicola*, cf. SCHUSTER 1969: 132, f. 108). On the other extreme there are oil bodies, which are composed of many (at least 40) globules and their size reaches the half cell length (e.g. *C. venezuelana*, see below). The shape varies from sphaeric to elongate and among the many colourless species there are a few with intensive blue, indigo or purplish colour. *Calypogeia laxa* belong the species with relatively small, colourless oil bodies and their unequal shape seemed to be characteristic, in which aspects is similar to the Japanese *Calypogeia tosana* (cf. HATTORI 1951: 74, f. 27–28, 98, f. I/14–15) and *C. granditexta* (HATTORI 1953: 76, f. I/7–8) or to *C. asakawana* (INOUE 1974: 32–33, f. 6).

Sierra de la Gran Piedra, Pico Gran Piedra, on shady granitic rocks at 1180 m alt. Coll. et det. T. PÓCS, 9200/Q, 31. Oct. 1980.

13. **Calypogeia peruviana** NEES et MONT. (Fig. 30)

The oil bodies of our specimen were medium sized, ellipsoid, *Calypogeia* type, purplish-violet in colour. The colour of the oil bodies of *C. peruviana* (if all investigated specimens belong
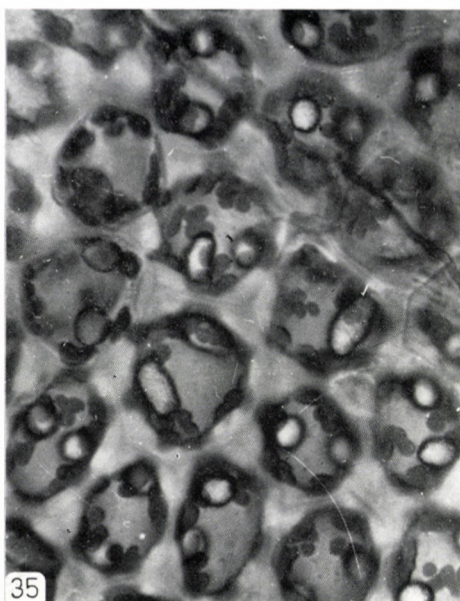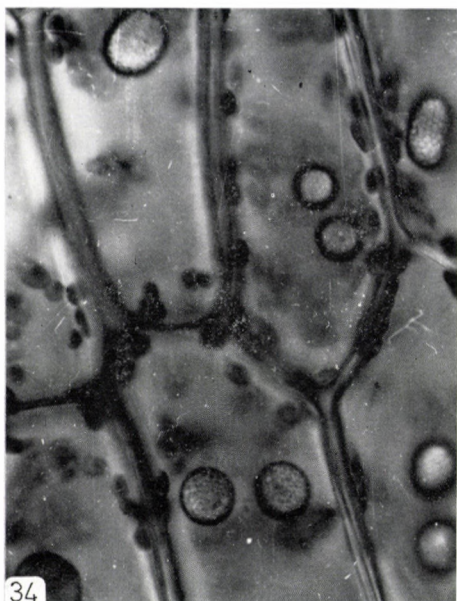
Fig. 34. Median leaf cells of *Alobiellopsis dominicensis* (SPR.) FULF. 9202/A
Fig. 35. Median leaf cells of *Odontoschisma denudatum* (MONT.) DUM. 9177/Y
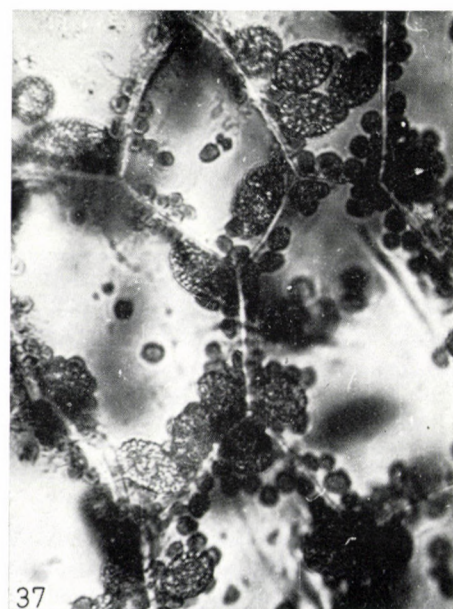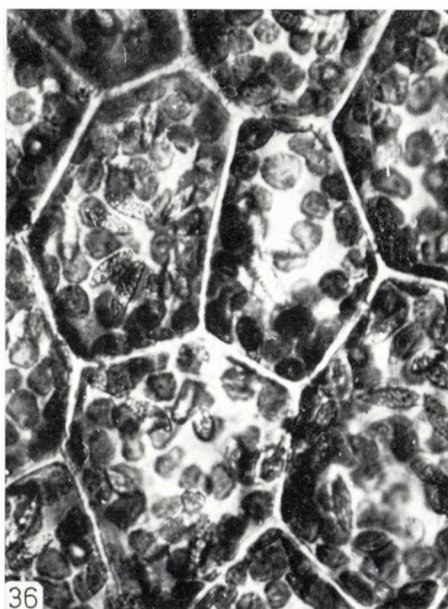
Fig. 36. Lower cell layer from the thallus of *Symphyogyna aspera* STEPH. 9197/K
Fig. 37. Lower cell layer of *Symphyogyna brasiliensis* NEES 9197/O

really to the same species) varies from pale azure through deep indigo blue and brownish violet to sepia or blue-black (cf. SCHUSTER 1969: 157, BREIL 1970: 420, GRADSTEIN, CLEEF and FULFORD, 1977: 391). The northern temperate *C. trichomanis* and the tropical African *C. afrocaerulea* have bright blue oil bodies too (cf. SCHUSTER 1969: 150, JONES 1976: 43) and seem to be related to the neotropic *C. peruviana*.

Sierra de la Gran Piedra. In the montane rain forest reserve behind Finca Isabelica, on rotting tree fern stem, at 1100 m alt. Coll. T. PÓCS and M. CALUFF, 9199/AC, 30. Oct. 1980, det. T. PÓCS.

14. **Calypogeia venezuelana** FULF. (Fig. 10, 31)

Oil bodies are relatively large, apiculate at both ends, slightly asymmetric. It is not easy to observe them due to the coarsely verruculose cuticle. They are absent in the amphigastria.

Cuchillas de Moa, 2 km N of La Melba, by the "Dos Comadres" falls, large masses on the soil, litter and on bark of trees in microphyllous forest on serpentine rocks, at 400 m alt. Coll. T. PÓCS and D. REYES M., 9170/S, 10 Oct. 1980. Det. T. PÓCS.

15. **Odontoschisma denudatum** (MART.) DUM. (Figs 11, 35)

The oil bodies of this widespread species are described and depicted by many authors, as by HATTORI (1951: 74, f. I/36–38, IV/3, 1953: 65, f. II/11) and by INOUE (1974: 127, f. 10) from Asia, by BREIL (1970: 438–439, f. 88) and by SCHUSTER (1974: 835, f. 468/2, 5, 6) from America. Our observations coincide well with the above ones: the oil bodies are of *Jungermannia* type, ovate, ellipsoidal or elongate, finely papillose on surface, in fact formed by the superficial sphaerules. There are 1–3 per cell, attaining sometimes almost the size of cell length.

Cuchillas de Moa, mossy elfin forest on the NW slope of Pico el Toldo at 1000–1100 m altitude. On rotting logs. Coll. T. PÓCS 9177/Y, 12. Oct. 1980. Det. J. VÁŇA.

16. **Odontoschisma longiflorum** (TAYL.) STEPH. (Fig. 12)

Its oil bodies are discussed also by GRADSTEIN et al. (1977: 409, f. 27). The oil bodies of Cuban specimen are similar, but the surface of its *Jungermannia* type oil bodies is more finely granulate papillose, than that of the Colombian one. While in the Cuban plant we observed 5–7 oil bodies per median leaf cells, they counted 8–15. Anyway, this species has more oil bodies per cell, than *O. denudata* and more of them are sphaeric in shape.

Cuchillas de Moa, 10 km S from Moa town, in degraded, semidry evergreen forest near La Breña, on tree fern stem and on litter, at 400–500 m alt. Coll. D. REYES M., 9173/P, det. J. VÁŇA.

17. ****Anomoclada mucosa** SPR. (Fig. 14)

The oil bodies are of *Calypogeia* type, 2–3 per cell, botryoidal, subglobose or ellipsoidal, composed of many sphaerules. Our records on the oil bodies might shed light on the uncertain affinity of *Anomoclada* to *Odontoschisma*. SCHUSTER (1974: 829) felt that the distinctions between the two genera are merely quantitative. Now, the discovery of the distinct oil body type seem to confirm the separation of the two genera. It makes necessary to revise even the subfamily characters of *Odontoschismatoideae*.

Cuchillas de Moa, near the "Dos Comadres" falls 2 km N of La Melba. On bark in microphyllous evergreen forest on serpentine rocks, at 400 m alt. Coll. T. PÓCS et D. REYES M. 9170/BH, 10. Oct. 1980, det. J. VÁŇA.

18. **Alobiellopsis dominicensis** (SPR.) FULF. (Figs 8, 34)

Our investigation agrees with that of SCHUSTER (1969b: 681, f. 9). The oil bodies of Cuban specimens are of *Jungermannia* type, globose to ellipsoidal, 1–2 per cell, finely botryoidal to granulose due to the protruding globules. They are very similar also to those of *Alobiellopsis parvifolia* from Japan pictured by INOUE (1974: 117, f. 1).

Sierra de la Gran Piedra. On stony and clayey roadcut surface behind Finca Isabelica, at 1100 m alt. Coll. T. PÓCS, 9202/A, 31. Oct. 1980, det. J. VÁŇA.

19. ***Cephaloziella antillana** (Spr.) Fulf. (Fig. 13)

Oil bodies of *Jungermannia* type, finely granulate or almost smooth, with indistinct globules, 0–4 (in general 2) per cell, sphaeric or ellipsoidal, about the size of the chloroplasts.

The very sparse literature records on the oil bodies of *Cephaloziellaceae* seem to refer mostly to *Massula* type oil bodies, as Hattori (1951: 100, f. 29, 30) on the Japanese *Cephaloziella echinata* and *C. godajensis*, or Jones (1976: 46) on the African *Cylindrocolea chevalieri*. On the other hand, Breil (1970: 437) reports granular oil bodies, which are only slightly smaller, than chloroplasts, 4–8 per cell, by the Caribbean *Cylindrocolea rhizantha*.

Together with the above *Alobiellopsis*, No. 9202/D, det. J. Váňa.

20. ***Lophocolea martiana** Nees (Fig. 32)

Oil bodies of *Calypogeia* type, coarsely botryoidal, sphaeric, subsphaeric or ellipsoid-elongate, 2–6 per cell. Although the greater part of *Lophocolea* species bears this type of oil bodies (e.g. *Lophocolea heterophylla* and *L. minor* — Hattori 1951: 75, f. 31–33, *L. horikawana* — Inoue 1959: 225, *L. javanica*, *L. costata* — Inoue 1979: 24, f. 3/B, C, *L. coadunata*, *L. trapezoidea* — Gradstein et al. 1977: 407, f. 24) other types also occur, like by *L. itoana*, which are small, nearly homogeneous with large oil chambers (Inoue 1959: 229).

Meseta del Guaso N of Guantánamo, on rotting logs in the entrance of a cave near Alto del Mango, at 770 m alt. Coll. T. Pócs and D. Reyes M., 9190/P, 23. Oct. 1980, det. J. Váňa.

21. **Lophocolea coadunata** (Sw.) Nees (Fig. 15)

Oil bodies of *Calypogeia* type, 2–6 per cell, ellipsoidal to acuminate-elongate, coarsely botryoidal. Its type agrees with that of the plants observed by Gradstein et al. (1977: 407, f. 24), but the Andean population has smaller, sphaerical oil bodies.

Meseta del Guaso N of Guantánamo. In a carstic depression at the N side of Alto del Mango. On rotting wood in a wet evergreen forest at 750 m alt. Coll. T. Pócs 9189/S, 23. Oct. 1980. Det. J. Váňa.

22. ***Heteroscyphus combinatus** (Nees) Schiffn. (Fig. 33)

Oil bodies of *Calypogeia* type, large, subglobose, coarsely botryoidal, 1–3 per cell, strong refracting. Although their shape is different from most of the known, more elongate *Heteroscyphus* oil bodies (Hattori 1951: 75, f. 29, I/25–26, III/34–35, II/49–50, V/8, Inoue 1974: 83, f. 1), their type and ground composition is similar.

Sierra de la Gran Piedra, montane rain forest reserve behind Finca Isabelica. Coll. T. Pócs and M. Caluff, 9199/EJ, 1. Nov. 1980, det. J. Váňa.

23. ***Leptoscyphus ovatus** (Spr.) Grolle (Fig. 16)

The peculiar elongate oil bodies of this species consist of 5–10 homogenous, translucent segments, which suggest the *Bazzania* type. The 4–5 elongate, crescent shaped oil bodies are arranged along the cell walls, together with the chloroplasts, leaving free the central cell part. This arrangement seems to be common within the genus, although the oil body types vary, as finely or coarsely granulose by the Andean *L. cleefii* and *L. porphyrius* (Gradstein et al. 1977: 403, f. 22), composed of small droplets (finely botryoidal?) by African species, as *L. expansus* or *L. iversenii* (S. Arnell 1963: 266–8, f. 194c, 195d). In the superficially similar genus *Mylia*, both coarsely botryoidal, *Calypogeia* type oil bodies (*Mylia anomala* — Schuster 1969: 1039, f. 299/7, *Mylia verrucosa* — Inoue 1974: 59, f. 9) and finely granulate, *Jungermannia* type oil bodies occur (*Mylia taylori* — Hattori 1951: 77, f. VI/12, Schuster 1969: 1043, f. 301/2).

Sierra de la Gran Piedra, along the streamlet Arroyo Negro SE de Finca Isabelica, on barks in montane evergreen forest at 1100 m alt. Coll. T. Pócs, D. Reyes M. and M. Caluff, 9208/L, 3. Nov. 1980. Det. J. Váňa.

24. ****Symphyogyna aspera** Steph. (Fig. 36)

The spindle shaped oil bodies, which fit most probably in the *Calypogeia* type, seem to be quite characteristic for the *Pallaviciniaceae* family. *Pallavicinia lyellii*, *P. longispina*

(HATTORI 1951: 90, f. II/51–52, V/14–15, 47, VI/41–42), and *P. isoblata* (INOUE 1976: 119, f. 2, 8) all have the same type. We could not find any record on the oil bodies of the genus *Symphyogyna*. 2 of the investigated 3 Cuban *Symphyogyna* have also spindle shaped oil bodies, which underlines the close relationship between *Pallavicinia* and *Symphyogyna*. In the case of *S. aspera* there are 4–20 o.b. per cell, finely botryoidal, translucent, occur mostly in the lower cell layers.

Sierra de la Gran Piedra, Subida de las Rosas, on shady, wet granitic rocks at 1100 m alt. Coll. T. Pócs and M. CALUFF, 9197/K, 29. Oct. 1980. Det. T. Pócs.

25. ****Symphyogyna brasiliensis** NEES (Fig. 37)

With sphaeric or compressed ellipsoidal oil bodies, which are prominent among the other species by their violet brown pigmentation. 1–6 occur in the deeper cell layers.

Locality, as by the above species, No. 9197/O, det. T. Pócs.

26. ****Symphyogyna digitisquama** STEPH. (Fig. 17)

Sphaeric and large, spindle shaped oil bodies mix, 0–2 per cell in the upper, 5–20 in the lower cell layers. Their surface is finely botryoidal.

Cuchillas de Moa, NE ridge of Revuelto de los Chinos, on the serpentinic soil of evergreen bush at 850–980 m altitude, coll. and det. T. Pócs, 9175/K, 12. Oct. 1980.

ACKNOWLEDGEMENTS

The authors are grateful to the Cuban and Hungarian Academies of Sciences sponsoring their research. They are especially indebted to J. VÁŇA, who identified a great part of the specimens.

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Acta Botanica Academiae Scientiarum Hungaricae, Vol. 27 (3–4), pp. 421–437 (1981)

DIVERSITY AND NICHE CHANGES OF SHRUB SPECIES WITHIN FOREST MARGIN*

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(Received: 3 August, 1981)

In a forest margin, ecotone formed along the meeting contact of a turkey-oak forest and a vineyard the change of diversity (species-individual, species-relative cover), equitability and evenness of the shrub species were studied from the edge of the forest margin towards the inside of the forest by means of transects. The change of niche-width and overlap of the species were examined in a niche-axis in the transects in the same direction. The niche-axis may correspond to the "light conditions". According to the change of diversity of species-relative cover the "ordering" of the shrub layer is increasing towards the inside of the forest. In the outer zone of the forest margin neither species have a competitive advantage. Proceeding towards the inside of the forest some species (*Cornus mas*, *Acer tataricum*, *Ligustrum vulgare*) take up the greater part of the niche-space and have a competitive advantage over the other species. As a response to the closing of the canopy layer the majority of the species will narrow their niche-width. From the results it can be drawn that in the examined forest the maximum width of the forest margin may be approximately 8 meters. Beyond this distance towards the inside of the forest the conditions of shrub-structure are already characteristic of the inside of the forest.

Introduction

An intermediate zone, the ecotone may often form in the zone of forest and unforested areas. The ecotones are rich in species because a part of species of both contact communities may appear in them. Apart from these species there are also ones which can be found more frequently only in the ecotones. The environmental effects are changing from the outer zone of the margin towards the inside of the community so the behaviour of the species can be studied along gradients by means of transects.

The vegetation of the forest margin plays a special role in the life of the forest. It often behaves as a "filter" and "protector" against the effects coming from outwards assuring in this way the (relative) undisturbed function and development of the inside of the forest (JAKUCS 1972).

The species composition, structures and functions of the vegetation of the forest margin are different to a certain extent from those of the forest and open (treeless) communities, respectively, bordering the forest. This difference can be seen, for example, in that some shrubs and herbs are growing more quickly and have more products than those living inside the forest (GHISELIN 1977, RANNEY 1977). In the forest shade tolerant species are prevailing, in the margin shade- and light-tolerant species are mixed; in the forest mesofrequent species can often be found, in the margin meso- and xerofrequent species also occur beside the previously mentioned ones (MCINTOSH 1957, RANNEY 1977, WALES 1972). These phenomena show

* Síkfőkút Project, No. 73.

that light, wind and soil-moisture have an essential part amongst microclimatic factors. The soil of the forest margin is different from that of the forest also in its supply with nutrients, chemical reaction and amount of humus (JAKUCS 1972, MCINTOSH 1957, MÉSZÁROS and JAKUCS 1981).

This study demonstrates the change in diversity and niche of the shrub species of the vegetation of a deciduous oak forest from the margin of the forest towards the inside of the forest.

The examined forest and forest margin

The forest (*Quercetum petraeae-cerris*), which in many respects can be considered homogeneous in a great extension, is a 70–75 year old stand of coppice origin. The MAB sample area in Hungary ("Síkfőkút Project"; JAKUCS 1973, 1979, PAPP and JAKUCS 1976).

The northern edge of the forest is in contact to a vineyard. In this edge an unbroken closed zone of margin vegetation, well observable also physiognomically, can be found. In the outer part — about 4 meters in width — of this zone the shrubs reach a height of even 3 meters and herbs can hardly be found under them. Above the thick shrub layer the cover of the foliage of the trees is 60% on average (in the inside of the forest it is 80%; JAKUCS, HORVÁTH and KÁRÁSZ 1975). The cover of the foliage above the margin is given by the trees standing in the edge of the closed forest, not by the ones rooting in the margin. The zone of shrub is constituted partly by species which are constant and dominant in the inside of the forest also (*Ligustrum vulgare, Cornus sanguinea, Acer tataricum, Quercus petraea, Euonymus europaeus, Euonymus verrucosus*), and partly by ones which have very low constancy and dominancy in the inside of the forest or are present not at all (*Crataegus monogyna, Viburnum antana, Prunus spinosa;* see: KÁRÁSZ 1976).

Method of sampling

3 transects of 4 times 8 meters and 2 transects of 4 times 12 meters were designated perpendicularly to the forest margin. The transects were divided into plots of 4 meters (Fig. 1). In these plots the percentage of cover of the shrub species was estimated in heights of 0.3, 1.0, 1.5, 2.0 and 3 meters, and the number of the individuals belonging to shrub species counted.

Method of evaluation

SHANNON–WEAVER's formula was used to calculate the diversity (H: SHANNON and WEAVER 1949). Beside it the equitability, J = H/log S where S means the number of species, as well as the evenness (NOSEK 1976) were also given. The evenness was calculated by the formula:

$$V = \frac{H - H_{l.min}}{H_{l.max} - H_{l.min}}$$

Values H, J and V, of species-individual and species-relative cover were calculated. Hl. min value of species-individuals was calculated so that one individual was attached to species n−1 and the remaining individuals, to one species (NOSEK 1976). To calculate $H_{l.min}$ value of the species-relative cover, a cover of 99% was attached to one species while the remaining 1% was evenly distributed among the other species (PRÉCSÉNYI 1981). The mentioned characteristics will be given from the edge of the forest margin towards the inside of the forest and also according to height levels.
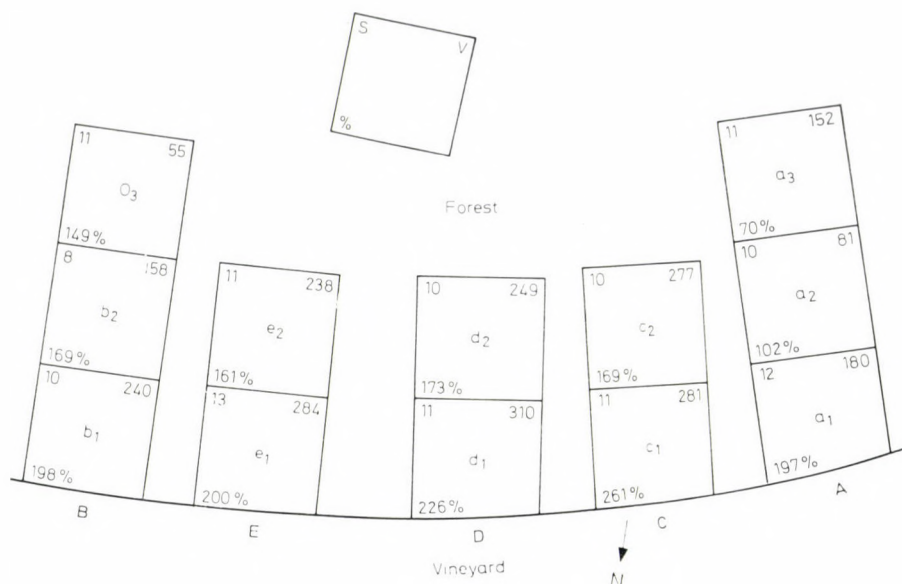
Fig. 1. Placing of the transects. S = number of species; N = Number of individuals; % = cover (sums of the cover from level to level)

SØRENSEN's (1948) similarity index was used for the floristic comparison of the plots.

The niche-width and overlap of the species were estimated in each plot of 16 m² on the basis of the values of relative cover falling to the height categories (0.3 m, 1.0 m, etc.), then the niche-widths and overlaps calculated in the plots, which were in equal distance from the outer edge of the margin (0 to 4 meters, 4 to 8 meters, 8 to 12 meters), were averaged for the evaluation. LEVINS' (1968) formulas were used for the calculation of the niche-width and overlap:

$$B_i = \frac{1}{\sum p_{ij}^2} ; \quad \alpha = \alpha_{hi} = \frac{\sum p_{hj} p_{ij}}{\sum p_{hj}^2} ; \quad \beta = \alpha_{ih} = \frac{\sum p_{hj} p_{ij}}{\sum p_{ij}^2}$$

On the basis of the overlap values the community effect was estimated by row-average of the community matrix for the zones of the margin vegetation while the species effect, by its column-average (VANDERMEER 1972).

Results

Before presentation of the results a few remarks on physiognomy are needed: proceeding inwards the transects, the total cover of individual of the shrubs is decreasing (Fig. 1 and Tables 1 and 2). In the plots of 8 to 12 meters (a_3, b_3) already their cover and number of individual, too, come close to the values characterizing the inside of the forest (KÁRÁSZ 1976). Towards the inside of the forest the foliage of the trees are closing more and more, at the same time the cover of the shrub level is loosening.

The maximum value of the cover of the shrub layer is vertically about in 1 m height from 0 to 4 meters and 4 to 8 meters away of the outer edge of the margin (on average 75.5% and 53.5%, respectively) and in plots 8 to 12 meters away from the edge of the margin it is in a height of 1.5 meters (on average 32.0%).

Table 1

Cover (%) of the shrub species estimated

	A					B				
	30 cm	1 m	1.5 m	2 m	3 m	30 cm	1 m	1.5 m	2 m	3 m
0–4 m										
Cornus sanguinea	25	30	35			10	6	2		
Rosa canina	10	10	20	5		1				
Frangula alnus	2									
Euonymus europaeus	3	5				4	1			
Acer tataricum		5	5	5		5	25	25	25	12
Euonymus verrucosus	5	3				8	5			
Ligustrum vulgare	15	3				15	7	3		
Prunus avium		3				1	1			
Crataegus oxyacantha	1									
Prunus spinosa	1					10	15	3		
Berberis vulgaris		2								
Cornus mas	1	3								
Quercus cerris						1				
Viburnum lantana										
Crataegus monogyna						1	3	3	3	3
Pyrus pyraster										
Sorbus domestica										
4–8 m										
Cornus sanguinea		7				3	12	15	3	
Rosa canina						1				
Frangula alnus		3								
Euonymus europaeus	1					1				
Acer tataricum	1	1	1	10		7	15	25	20	3
Euonymus verrucosus	10	8	15	12		5	4			
Ligustrum vulgare	2					10	15	15		
Crataegus oxyacantha	4	8	8	8						
Prunus spinosa	1					3	5	5		
Cornus mas						1				
Quercus petraea	1									
Acer campestre	1									
Quercus cerris						1				
Viburnum lantana										
Crataegus monogyna										
Pyrus pyraster										
Lonicera xylosteum										
8–12 m										
Cornus sanguinea						3	5			
Rosa canina	1	2					1			
Frangula alnus	2					1				
Acer tataricum	1	6	20	5		1	2	3		
Euonymus verrucosus	6	2				1				
Ligustrum vulgare	10					10	15	5	1	
Prunus avium	1	1								
Crataegus oxyacantha	1									
Prunus spinosa	1					1	1			
Cornus mas						5	20	30	20	15
Quercus petraea	1		2							
Acer campestre								2	3	
Quercus cerris	1					1				
Viburnum lantana	3	2	1							
Pyrus pyraster						1	2			
Rhamnus catharticus			1							

in various heights in plots of 16 m²

C					D					E				
30 cm	1 m	1.5 m	2 m	3 m	30 cm	1 m	1.5 m	2 m	3 m	30 cm	1 m	1.5 m	2 m	3 m
2	7	3	1		0.5	10				2.5	4	7		
2	10	15	7		2	10	20	5		2	25	15	5	
1	2	3			1	3				1	1	2		
3	10	7	3		3	10	15	20		2	7	2		
2	5				5	5				5	8	3		
25	10	10			30	20	7			10	15			
10	10				0.5	3				5				
	15	25	20			2	10	7	5	1				
1	15	15	5		7	20				10	7	10		
2										1				
2	3	5	5		1	2				1				
										2	10	20	10	5
					1	1								
											0.5	0.5		
20	25	10	7		1	15				20	22			
0.5	5	7								0.5	1			
											1			
5										1.5	0.5			
2	10	5			5	7				2	7	12	5	
3	5				2	8				8	15	10		
10	3				30	20	2			5	2			
5	10	15	5		0.5					0.5	8	10	18	8
2	7				1	4	2			0.5				
						3	30	35						
						3	0.5							
1	3													
					1	1								
0.5	3				0.5					2				
										0.5	0.5			
					0.5	0.5								

Table 2

Number of individuals of the shrub species in plots of 16 m² of the transects

Transect	A			B			C		D		E	
	0–4	4–8	8–12	0–1	4–8	8–12	0–4	4–8	0–4	4–8	0–4	4–8
	m			m			m		m		m	
Cornus sanguinea	78	14	—	28	44	4	7	87	11	15	29	75
Rosa canina	11	—	4	2	2	3	24	3	20	—	36	4
Frangula alnus	7	8	6	—	—	5	—	—	—	—	—	1
Euonymus europaeus	19	1	—	13	1	—	4	16	5	—	4	11
Acer tataricum	16	3	37	30	17	10	34	22	23	9	10	11
Euonymus verrucosus	12	34	10	42	48	1	10	19	17	39	55	95
Ligustrum vulgare	29	4	59	93	23	20	121	83	207	146	84	20
Prunus avium	2	—	5	3	—	—	47	—	2	—	10	—
Crataegus oxyacantha	1	8	1	—	—	—	2	9	1	—	2	13
Prunus spinosa	1	6	1	26	21	4	21	32	21	31	41	3
Berberis vulgaris	1	—	—	—	—	—	—	—	—	—	—	—
Conus mas	3	—	—	—	1	1	—	—	—	1	—	—
Quercus petraea	—	2	4	—	—	—	—	—	—	1	—	—
Acer campestre	—	1	—	—	—	1	—	—	—	—	—	—
Quercus cerris	—	—	2	2	1	3	3	2	—	—	7	—
Viburnum lantana	—	—	22	—	—	—	8	—	2	4	3	—
Crataegus monogyna	—	—	—	1	—	—	—	4	—	1	2	2
Pyrus pyraster	—	—	—	—	—	3	—	—	1	—	—	3
Rhamnus catharticus	—	—	1	—	—	—	—	—	—	—	—	—
Sorbus domestica	—	—	—	—	—	—	—	—	—	—	1	—
Lonicera xylosteum	—	—	—	—	—	—	—	—	—	2	—	—

Table 3

Floristic similarity of the plots

	a_2	a_3	b_1	b_2	b_3	c_1	c_2	d_1	d_2	e_1	e_2
a_1	0.73	0.67	0.73			0.78		0.78		0.72	
a_2		0.64		0.63			0.70		0.67		0.76
a_3					0.61						
b_1				0.84	0.67	0.84		0.76		0.87	
b_2					0.80		0.84		0.60		0.70
c_1							0.86				
d_1									0.64		
e_1											0.75

Floristic similarity of the plots

Similarity within transect

The plots following each other in the transects show a high floristic similarity, except plots e_{1-2} (Table 3). The similarity of the plots farther from each other (e.g. a_{1-3}) is slightly less than that of the above mentioned ones. The plots of transect "B" following each other (b_{1-2}, b_{2-3}) show a high similarity.

Table 4

Floristic similarity of the plots in various heights

	m	a_2	a_3	b_2	b_3	c_2	d_2	e_2
	0.3	0.59	0.60					
a_1	1.0	0.43	0.57					
	1.5	0.33	0.29					
	2.0	0.40						
	0.3		0.63					
a_2	1.0		0.40					
	1.5		0.29					
	0.3			0.84	0.63			
b_1	1.0			0.77	0.53			
	1.5			0.89	0.44			
	2.0			0.50				
	0.3				0.78			
b_2	1.0				0.67			
	1.5				0.50			
	0.3					0.80		
c_1	1.0					0.74		
	1.5					0.67		
	2.0					0.50		
	0.3						0.63	
d_1	1.0						0.60	
	1.5						0.25	
	0.3							0.82
e_1	1.0							0.67
	1.5							0.36

Similarity between transects

The floristic similarity of the equidistant plots of the respective transects was also examined (e.g. a_1–b_1; a_2–b_2; etc., Table 3). The values of the plots of 0 to 4 meters (a_1, b_1, etc.) exceed those of the plots of 4 to 8 meters (a_2, b_2, etc.). Proceeding inwards the forest the value of similarity is generally decreasing, however, it remains above 0.5 without exception.

Change of the similarity within transect according to the height

The floristic similarity of the plots is decreasing with the increase of the height (Table 4). In most instances the floristic similarity suddenly decreases in heights from 0.3 m to 1.0 m and 1.0 to 1.5 meters, respectively. It can be explained partly by that the majority of the shrubs reaches a height of 0.3 to 1 m and partly by that the number of common species is decreasing due to the various light conditions.

Diversity

Species-individual diversity

Proceeding from the outer edge of the margin inwards the forest in transect "A" the diversity, equitability and evenness are hardly changing (Table 5). In plot a_1 the *Cornus sanguinea*, in plot a_2 the *Euonymus europaeus* while in plot a_3 the *Ligustrum vulgare* are represented by most individuals.

Table 5

Species-individual diversity (H), equitability (J) and evenness (V)

Transect	A	B	C	D	E	Average
0–4 m						
H	0.7783	0.7553	0.7720	0.5507	0.8585	0.7430
J	0.7212	0.7553	0.7413	0.5288	0.7707	0.7035
V	0.6714	0.7263	0.7129	0.4824	0.7430	0.6672
4–8 m						
H	0.7766	0.7200	0.7734	0.5747	0.7050	0.7099
J	0.7766	0.7546	0.7734	0.5747	0.6770	0.7113
V	0.6994	0.7152	0.7502	0.5266	0.6359	0.6655
8–12 m						
H	0.7634	0.8562				0.8098
J	0.7074	0.8222				0.7648
V	0.6457	0.7167				0.6812

In transect "B" the diversity and equitability of the plot (b_3) in the direction of the inside of the forest are greater than those of the other two plots. The evenness is almost the same in the three plots. The reason of the increase in diversity is that there is no such a prominent value in the number of individuals in plot b_3 than in the other two plots. The low diversity, equitability and evenness in transect "D" are due to the great number of individuals of *Ligustrum vulgare*.

In the inside of the forest the species-individual diversity of the shrubs is 0.9378, their equitability is 0.7788, calculating on KÁRÁSZ's (1973) data. In the transects lower values H are obtained but the equitability — excepting transects "D" and "E" — is approximately the same.

Species-relative cover diversity

In plots of 16 m^2 the species-relative cover diversity, equitability and evenness were examined partly on the basis of addition of the cover percentages estimated from species to species in various heights (Table 6) and partly vertically, on the basis of the cover percentages estimated from species to species in the height levels (Table 7).

The species-relative cover diversity, equitability and evenness calculated on the basis of the species cover summed from level to level are increasing towards the inside of the forest in transect "A" and decreasing in the other transects. The highest values for H, J and V were obtained in transect "C" while the lowest ones, in transect "B".

Table 6

Species-relative cover diversity (H), equitability (J) and evenness (V)

Transect	A	B	C	D	E	Average
0–4 m						
H	0.7210	0.7216	0.9236	0.8600	0.8828	0.8218
J	0.6681	0.7216	0.8869	0.8258	0.7925	0.7790
V	0.6603	0.7119	0.8830	0.8199	0.7858	0.7722
4–8 m						
H	0.6619	0.6514	0.8202	0.7054	0.7371	0.7152
J	0.6619	0.6827	0.8202	0.6774	0.7078	0.7100
V	0.6501	0.6712	0.8139	0.6664	0.6978	0.6999
8–12 m						
H	0.7864	0.5655				0.6760
J	0.7287	0.5430				0.6359
V	0.7197	0.5275				0.6236

Table 7

Species-relative cover diversity (H), equitability (J) and evenness (V) in the plots in various heights

		a_1	a_2	a_3	b_1	b_2	b_3	c_1	c_2	d_1	d_2	e_1	e_2
	H	0.7182	0.7026	0.8505	0.8419	0.8090	0.7585	0.7112	0.7647	0.6201	0.4622	0.9273	0.6786
0.3 m	J	0.7527	0.7780	0.8167	0.8419	0.8478	0.7949	0.7112	0.7647	0.6201	0.4844	0.8592	0.6786
	V	0.7437	0.7696	0.8104	0.8364	0.8423	0.7875	0.7011	0.7565	0.6068	0.4657	0.8546	0.6674
	H	0.7496	0.6241	0.6158	0.7184	0.6460	0.6114	0.9426	0.8352	0.8927	0.7820	0.8067	0.6924
1.0 m	J	0.7856	0.8929	0.8810	0.7955	0.9242	0.7235	0.9426	0.8753	0.8572	0.8195	0.8454	0.7256
	V	0.7778	0.8880	0.8756	0.7878	0.9207	0.7125	0.9406	0.8708	0.8523	0.8130	0.8398	0.7157
	H	0.3855	0.3442	0.2710	0.4495	0.5494	0.3560	0.8044	0.5668	0.5703	0.2229	0.7314	0.4755
1.5 m	J	0.8080	0.7214	0.4501	0.6431	0.9125	0.5913	0.8907	0.9414	0.9472	0.3702	0.8099	0.9966
	V	0.7964	0.7045	0.4222	0.6269	0.9080	0.5705	0.8866	0.9384	0.9445	0.3382	0.8027	0.9964
	H	0.3010	0.4713		0.1478	0.1681	0.2364	0.6285	0.2950	0.3980		0.2764	0.2774
2.0 m	J	1.0000	0.9878		0.4910	0.5585	0.4955	0.8076	0.9801	0.8342		0.9183	0.7555
	V	1.0000	0.9871		0.4463	0.5197	0.4649	0.7997	0.9783	0.8241		0.9111	0.7340
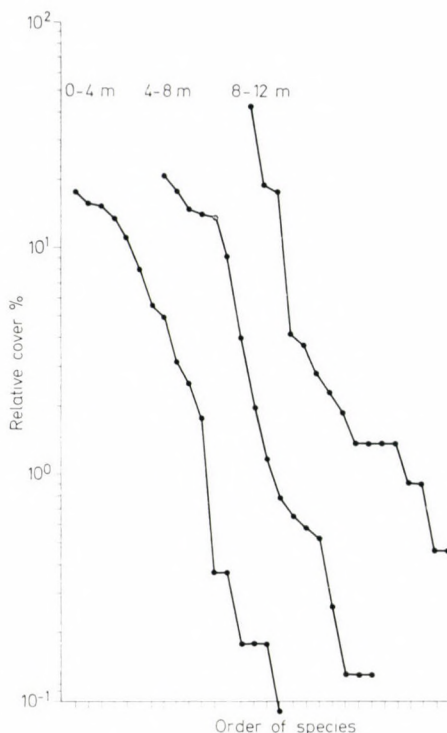
Fig. 2. Dominance-diversity curves

Proceeding vertically upwards, the diversity is generally decreasing. The high diversity values are most often shown in the level of 0.3 to 1 m, and the low ones, in the level of 2 meters. In some instances the change of the equitability and evenness is similar to that of the diversity. In instances (e.g. a_1 and a_2) where 2–3 species can be found in the examined level having approximately the same cover, the equitability and evenness will be high. At the same time the diversity will be lower than in levels containing.

Dominance-diversity curves

The dominance-diversity curves were constructed on the basis of the relative cover values as values of importance (WHITTAKER 1965). In the equidistant plots of the transects the cover values of the species were averaged, the averages were summed, and the relative cover of the species were expressed in the percentage of the sum (Fig. 2).

In semi-logarithmic plotting the dominance-diversity curve relating to the zone of 0 to 4 meters approaches to a sigmoid shape. On the upper part of the curve four or five species are in the vicinity of each other (*Acer tatari-*

Table 8

Community matrix for the outer

a_{hi} / a_{ih}	*Cornus sanguinea*	*Rosa canina*	*Euonymus europaeus*	*Acer tataricum*	*Euonymus verrucosus*	*Ligustrum vulgare*
Cornus sanguinea	2.3200	0.8182	0.9466	0.5973	0.8886	0.5349
Rosa canina	0.7864	2.4799	0.7692	0.7109	0.6602	0.6511
Euonymus europaeus	0.8676	0.7187	2.0382	0.5014	0.8091	0.7170
Acer tataricum	0.7422	0.7389	0.6911	3.1144	0.7416	0.6882
Euonymus verrucosus	0.7942	0.6361	0.8443	0.5473	2.0167	1.0979
Ligustrum vulgare	0.6696	0.6435	0.7749	0.5880	0.9266	2.0759
Cornus mas	0.9572	1.0940	2.7696	1.2309	2.1541	1.6416
Prunus avium	0.6380	0.3870	0.6548	0.3309	0.6700	0.5445
Prunus spinosa	0.8515	0.6241	0.8484	0.5014	0.8380	0.7595
Crataegus monogyna	0.8437	0.6556	0.7315	0.8949	0.6610	0.5703
Crataegus oxyacantha	0.3646	0.5332	0.4168	0.4640	0.3967	0.6300
Viburnum lantana	0.9980	0.6827	0.9814	0.5889	0.7731	0.7125
Pyrus pyraster	1.0000	0.3244	1.0000	0.2708	1.0000	0.8772
Species effect	0.7928	0.6547	0.9524	0.6022	0.8766	0.7854

Values B_1 in the main diagonal

cum, *Ligustrum vulgare*, *Rosa canina*, *Cornus sanguinea*, *Prunus spinosa*). It shows partly that there is no species which would have a considerable competitive advantage over the other species and take up the greater part of the nichespace, and partly that the environmental conditions are favourable for more species. The latter remark is supported by the fact, too, that the average of species-relative cover diversity, equitability and evenness is highest also in this zone.

The curve relating to the zone of 4 to 8 meters is also approaching to the sigmoid shape but the species found in the preceding one only partly can be found on its top (*Cornus sanguinea*, *Acer tataricum*, *Ligustrum vulgare*; new species: *Euonymus verrucosus*, *Crataegus oxyacantha*) and the order of the species is also different. There is no species either in this zone which would take up the greatest part of the nichespace by oneself. The average diversity, equitability and evenness values are lower than in the zone of 0 to 4 meters.

The shape of the curve relating to the innermost zone (8 to 12 meters) is different from that of the preceding two curves. The first section of this curve shows a great similarity with the curve of the geometric series (WHITTAKER 1965). In this section three species (*Cornus mas*, *Acer tataricum* and *Ligustrum vulgare*) can be found, which take up the great part of the nichespace. According to this the average diversity is lowest in this zone.

(0 to 4 m) zone

Cornus mas	*Prunus avium*	*Prunus spinosa*	*Crataegus monogyna*	*Crataegus oxyacantha*	*Viburnum lantana*	*Pyrus pyraster*	Community effect
0.5727	0.8636	0.8542	0.5411	0.5168	0.6888	0.5499	0.6977
0.7200	0.4973	0.6689	0.3821	0.6415	0.6882	0.4198	0.6330
1.0587	0.8614	0.8189	0.4480	0.5556	0.8153	0.8000	0.7476
0.7500	0.7089	0.6039	0.6947	0.5286	0.6454	0.4250	0.6632
0.8235	0.8633	0.8588	0.3898	0.5870	0.6529	1.0000	0.7579
0.4616	0.7658	0.8036	0.2921	0.6784	0.7309	1.0564	0.6993
4.9237	3.6928	1.2309	—	1.2309	—	—	1.7780
0.7500	1.4649	0.5196	0.3077	0.3362	0.5770	0.6623	0.5315
0.2500	0.7656	2.1230	0.5409	0.7667	0.9421	0.8118	0.7083
—	0.7027	0.8149	4.0387	0.1496	—	—	0.6694
0.2500	0.3978	0.6259	0.0426	2.0289	0.5219	0.1347	0.3982
—	0.8550	1.0443	—	0.5859	2.6863	0.8993	0.8121
—	1.0000	1.0000	—	0.0831	1.0000	2.0000	0.7556
0.6263	0.9979	0.8203	0.4043	0.5550	0.7263	0.6759	

Niche-width and overlap

A niche-axis was formed on the basis of the cover estimated from species to species in various heights. This axis corresponds to the "light conditions".

On the basis of the niche-width (community matrix Tables 8, 9 and 10) the species can be divided into the following groups: 1. There is species of which the niche-width is unchanged proceeding inwards from the edge of the margin: *Pyrus pyraster*; 2. Species of which the niche-width is narrow in the second zone (4 to 8 meters) and wide in the first (0 to 4 meters) and third (8 to 12 meters) zones: *Cornus mas* and *Viburnum lantana*; 3. Species of which the niche-width is narrow in the first and third zones and wide in the second zone: *Euonymus verrucosus* and *Crataegus oxyacantha*; 4. The niche-width of the following species is narrowing from the outer zone towards the inside of the forest: *Acer tataricum*, *Rosa canina*, *Cornus sanguinea*, *Prunus spinosa*, *Ligustrum vulgare*.

The average of the niche-width of these 10 species is also decreasing from the outer edge of the margin towards the inside of the forest.

The conclusion can be drawn from the community matrix that in the outer zone the overlap is great between *Prunus avium* and *Cornus mas*, *Cor-*

Table 9

Community matrix for the

a_{ih} \ a_{hi}	*Cornus sanguinea*	*Rosa canina*	*Euonymus europaeus*	*Acer tataricum*	*Euonymus verrucosus*	*Ligustrum vulgare*
Cornus sanguinea	2.0435	0.7118	0.5716	0.5822	0.7130	0.8666
Rosa canina	0.5205	1.6348	0.6113	0.4403	0.6014	0.6268
Euonymus europaeus	0.2986	0.5689	1.1500	0.1236	0.4064	0.7477
Acer tataricum	0.7021	0.6354	0.2863	2.5240	0.7685	0.5671
Euonymus verrucosus	0.7816	0.8904	0.8687	0.7323	2.3856	0.7477
Ligustrum vulgare	0.7844	0.5474	0.9865	0.4621	0.6343	1.8446
Cornus mas	0.0903	1.0000	1.0000	0.0779	0.3160	0.1618
Prunus spinosa	0.6595	0.4945	0.6877	0.5010	0.6651	0.7944
Crataegus monogyna	0.3525	0.4617	0.4697	0.3946	0.4076	0.5662
Crataegus oxyacantha	0.5754	0.8095	0.1237	0.8237	0.6819	0.4757
Viburnum lantana	1.0000	—	—	1.0000	1.0000	0.9616
Pyrus pyraster	1.0000	1.0000	1.0000	0.3462	0.6970	1.0000
Species effect	0.6150	0.7120	0.6606	0.4985	0.6265	0.6833

Values B_1 in the main diagonal

Table 10

Community matrix for the

a_{ih} \ a_{hi}	*Cornus sanguinea*	*Rosa canina*	*Acer tataricum*	*Euonymus verrucosus*	*Ligustrum vulgare*
Cornus sanguinea	1.8822	1.1764	0.5097	0.7058	0.7969
Rosa canina	0.6250	1.4000	0.2886	0.3750	0.5419
Acer tataricum	0.6963	0.5786	2.3939	0.2923	0.4927
Euonymus verrucosus	0.3750	0.3334	0.1397	1.3000	0.7613
Ligustrum vulgare	1.1590	0.8290	0.5032	0.8166	1.8688
Cornus mas	0.6635	0.9231	1.0386	0.2310	0.7744
Prunus avium	—	1.0000	0.2188	1.0000	1.0000
Prunus spinosa	1.0000	0.6667	0.2657	0.8750	0.9033
Crataegus oxyacantha	—	0.3333	0.0313	0.7000	1.0000
Viburnum lantana	—	1.0000	0.4688	1.1785	1.2857
Pyrus pyraster	0.9750	1.2000	0.5000	0.5999	0.7741
Species effect	0.7848	0.8041	0.3964	0.6774	0.8280

Values B_1 in the main diagonal

middle (4 to 8 m) zone

Cornus mas	*Prunus spinosa*	*Crataegus monogyna*	*Crataegus oxyacantha*	*Viburnum lantana*	*Pyrus pyraster*	Community effect
0.1513	0.7547	0.7679	0.3406	0.5664	0.9978	0.6385
1.0000	0.5014	0.7335	0.4901	—	0.8999	0.6425
1.0000	0.6633	0.1661	0.1237	—	0.8000	0.4898
0.2124	0.6237	0.7375	0.6653	0.9730	0.5271	0.6089
0.5748	0.7800	0.7072	0.5976	0.7353	0.9758	0.7629
0.3988	0.8813	0.9602	0.4281	0.9970	0.8449	0.7097
1.5834	0.2793	0.0000	0.0000	0.0000	—	0.2973
0.5071	1.7453	0.8003	0.2190	0.6667	0.5000	0.5905
0.0000	0.6893	1.1082	0.4542	0.5000	0.5000	0.4360
0.0000	0.3878	0.6355	2.9052	0.5000	0.3424	0.4869
0.0441	0.5714	1.0000	1.0000	2.0000	—	0.8221
—	1.0000	1.0000	0.1910	—	2.0000	0.8038
0.3889	0.6484	0.6826	0.4100	0.6233	0.7098	

inner (8 to 12 m) zone

Cornus mas	*Prunus avium*	*Prunus spinosa*	*Crataegus oxyacantha*	*Viburnum lantana*	*Pyrus pyraster*	Community effect
0.3006	—	0.9411	—	—	1.0195	0.7786
0.2222	0.8999	0.5500	0.5999	0.6999	0.6667	0.5469
0.6428	0.2425	0.3561	0.0694	0.4041	0.3125	0.4087
0.0556	0.8000	0.8500	1.2000	0.7333	0.3333	0.5582
0.5103	0.5000	1.0520	1.0000	0.5000	1.2072	0.8077
4.1545	—	0.5771	—	—	0.6924	0.7000
—	2.0000	1.0000	1.0000	0.8333	—	0.8646
0.2778	0.5000	1.5000	1.0000	0.5000	1.0000	0.6989
—	0.5000	1.0000	1.0000	0.5000	—	0.5807
—	1.0715	1.2857	1.2857	2.5714	—	1.0823
0.3000	—	0.8999	—	—	1.7999	0.7498
0.3299	0.6448	0.8512	0.8793	0.5958	0.7474	

nus mas and *Euonymus europaeus* and *Cornus mas* and *Euonymus verrucosus*, respectively. Great overlap values, like the preceding ones, cannot be found in the middle zone. In the inner zone *Viburnum lantana* has a considerable overlap with *Ligustrum vulgare* and *Crataegus oxyacantha* further on there is a great overlap between *Crataegus oxyacantha* and *Euonymus verrucosus*, *Ligustrum vulgare* and *Pyrus pyraster*.

In the outer zone the highest community effect can be found at *Cornus mas* while the lowest one, at *Crataegus oxyacantha* (Table 8). The species effect is highest at *Prunus avium*, *Euonymus europaeus* is close to it. The species effect is lowest at *Crataegus monogyna*.

In the middle zone the community effect is approximately of the same greatness at *Viburnum lantana* and *Pyrus pyraster* and is lowest at *Cornus mas* (Table 9). The species effect is high in case of 9 species, and comparing to the preceding ones, it is low in case of 3 species.

In the inner zone the species have the greatest effect on *Viburnum lantana* and the smallest one on *Acer tataricum* (Table 10). The species effect of *Crataegus oxyacantha*, *Prunus spinosa*, *Ligustrum vulgare* and *Rosa canina* is approximately of the same greatness. *Acer tataricum* and *Cornus mas* have similarity effect on the other species.

In case of *Viburnum lantana* a great community effect can be generally found in each zone while in case of *Rosa canina*, *Acer tataricum* and *Crataegus oxyacantha* a very small one can be found. *Prunus spinosa* and *Ligustrum vulgare* have great effect on the other species. *Acer tataricum* and *Cornus mas* exert a small effect on the other species.

Conclusions

The species-relative cover diversity of the shrubs is decreasing from the edge of the forest margin towards the inside of the forest. This means an increase in the "ordering" of the shrub layer from this point of view.

In the outer zones of the forest margin the microclimatic and soil factors render the existence of many species possible so that none of the species has a competitive advantage over the other species. Proceeding inwards the forest the environmental factors are modified and the competitive relations are changing due to the closing of the foliage of the trees. The species which most adapted to the modified conditions take up the greater part of the niche-space. Most of the shrub species response for the shading intensifying inwards the forest with narrowing their niche-width.

The community and species effects are variable, in the various zones different species show high and low values. The community effect is generally high in case of *Viburnum lantana* and low in case of *Rosa canina*, *Acer tatari-*

cum and *Crataegus oxyacantha. Prunus spinosa* and *Ligustrum vulgare* have great effect on the other species, *Acer tataricum* and *Cornus mas* have a small one.

On the basis of floristic similarity, species-relative cover diversity, evenness and dominance-diversity curves it can be stated that the greatest width of the margin of the turkey-oak forest is appr. 8 meters. Inner from this distance shrub-structure characterizing the inside of the forest can be found.

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Acta Botanica Academiae Scientiarum Hungaricae, Vol. 27 (3–4), pp. 439–454 (1981)

PALMAS NUEVAS DEL GÉNERO COCCOTHRINAX SARG. EN CUBA

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(Llegado en: 1 de enero, 1980)

The authors made a new revision of the Cuban species of the palm genus *Coccothrinax* SARG. Collected and described 7 new species and 1 subspecies new to science. These are: *C. baracoensis* BORHIDI et MUÑIZ sp. n., *C. camagüeyana* BORHIDI et MUÑIZ sp. n., *C. elegans* MUÑIZ et BORHIDI sp. n., *C. leonis* MUÑIZ et BORHIDI sp. n., *C. microphylla* BORHIDI et MUÑIZ sp. n., *C. nipensis* BORHIDI et MUÑIZ sp. n., *C. yunquensis* BORHIDI et MUÑIZ sp. n., *C. crinita* (GRISEB. et WENDL.) BECC. ssp. *brevicrinis* BORHIDI et MUÑIZ ssp. n.

As further results of the taxonomic revision authors recognized 6 of earlier described infraspecific taxa as valid species and placed them into a new state. These are: *C. cupularis* (LEÓN) MUÑIZ et BORHIDI stat. n., *C. guantanamensis* (LEÓN) MUÑIZ et BORHIDI stat. n., *C. macroglossa* (LEÓN) MUÑIZ et BORHIDI stat. n., *C. moaensis* (BORHIDI et MUÑIZ) MUÑIZ stat. n., *C. orientalis* (LEÓN) MUÑIZ et BORHIDI stat. n., *C. savannarum* (LEÓN) BORHIDI et MUÑIZ stat. n.

Introducción

Las palmas constituyen una familia de gran importancia por su valor económico y etnobotánico y por su caracteristica fitogeográfica. Esta familia es una de mayor representación con especies endémicas en nuestra flora — con más de 90 % de endémicos. El género *Coccothrinax* es el mas rico en espécies entre las palmas de la flora de Cuba. Por esta razón el Archipiélago Cubano debe considerarse como un centro de evolución de este género.

La primera especie de este género fue colectado y descrito por HUMBOLDT, BONPLAND y KUNTH (1815) la segunda por A. RICHARD (1850). Dos espécies fueron descritas por GRISEBACH y WENDLAND (1866, 1871) de la colección de CH. WRIGHT. EKMAN descubrió otras dos especies mas, las que fueron descritas por BURRET (1929). La gran mayoria de las especies cubanas se descubrieron por LEÓN. Este autor en una obra fundamental (1939) logró a describir no menos de 14 especies nuevas. Desde esa fecha nueve especies nuevas fueron descubiertas. Una de estas se publicó por BORHIDI (in BORHIDI et MUÑIZ 1971) y una otra por MUÑIZ (in BORHIDI, IMCHANITSKAYA y MUÑIZ 1978). Las demás 7 especies nuevas para la ciencia van a publicarse en este articulo. Los resultados de una revisión taxonómica de las espécies cubanas confeccionada por O. MUÑIZ y A. BORHIDI convencieron a los autores de lo que la espécie particular *C. crinita* se divide en dos subespécies geográficamente vicariadas y que 6 otros taxones infraespecificas descritas con anterioridad, deben considerarse como espécies válidas. Con todas estas el numero de las especies del género *Coccothrinax* representadas actualmente en la flora de Cuba se ha elevado a 34.

Resultados

Coccothrinax baracoensis Borhidi et Muñiz spec. nov.

Palma 4–8 m alta; caudex robustus cylindraceus, ±20 cm in diametro. Vagina frondis integra, oblongo-ovata, usque ad 55 cm longa et 20 cm lata; pars libera oblongo-triangularis, 20 cm longa, apice acuta vel obtusa, fibris 1–1,5 mm latis, rigide coriaceis dense intertextis apicem versus attenuatis formata. Petiolum 100–110 cm longum, pars libera 70–80 cm longa, basi 2 cm latum, pars angustissima, 1,3 cm lata, apice 1,8 cm lata, dorso late prominenter carinata, superficie albo-cerosa. Ligula triangularis, robusta, valde rigida, apice acuta, lateraliter revoluta, 1,6 cm longa. Limbus frondis orbicularis, 90–95 cm longus et 95–100 cm latus. Segmenta 29–32, centralia 48–52 cm longa et 6,5 cm lata, parce attenuata in apicem elongatam, 11–12 cm longam excurrentia, apice ipso plerumque obliquo, obtuso et bifido; segmenta basi usque ad 14 cm longe connata, marginalia 35–40 cm longa supra pallide viridia, squamis cerosis obsita, nervis secundariis et tertiariis crassis, remotis, 0,7–1 mm longe distantibus suffulta, subtus argentea, pilis albis adpresse tomentosa et punctis minutis fuscis numerosis satis dense obtecta.

Spadix usque ad 80–85 cm longus, adscendens, rectus, spathis 9 dense copertus; spathae coriaceae, lanceolatae, margine et superne squamis longe fimbriato-pilosis dense tomentosa. Inflorescentiae partiales 4, 20–30 cm longae. Pedicelli 0,5–2 mm longi, bracteolae lanceolatae, pedicellum superantes. Lobi perianthii 6, triangulari-subulati, basi connati, stamina 6–8, filamenta subulata. Ovarium maturum obovatum vertice compressum. Fructus subsessilis, late obovato-subglobosus, vertice compressus, 9–11 mm longus et 11–12 mm in diametro. Semina depresse-globosa, 8 mm longa et 10 mm lata, 6-fissurata usque ad basem. Albumen ruminatum, embryo basalis.

Holotypus: O. Muñiz 15105; Cuba; Prov. Oriente (Baracoa) Arroyo Blanco al Oeste de Baracoa. Leg.: Barbara Muñoz et R. Fleites 19. febr. 1978. HAC.

Palma de 4–8 m de altura; tronco robusto de unos 20 cm de diámetro. Vaina de la hoja oblongo-aovada, hasta 55 cm de largo y 20 cm de ancho, parte libre oblongo-triangular de 20 cm de largo, aguda u obtusa en el ápice, formada por fibras de 1–1.5 mm de ancho, densamente entretejidas de consistencia coriácea, estrechadas hacía el ápice sin puntas libres. Pecíolo de 1–1.1 m de largo, parte libre de 70–80 cm de largo, 2 cm de ancho en la base, la parte mas estrecha 1.3 cm, y 1.8 cm en el ápice, con una capa de cera y con costa prominente en el envés. Ligula robusta, muy rígida, triangular, aguda en el ápice, 1.6 cm de largo, lateralmente revoluta. Limbo orbicular de 90–95 cm de largo y 95–100 cm de ancho; segmentos 29–32, los centrales de 48–52 cm de largo y 6.5 cm de ancho, muy poco estrechados en una punta alargada de 11–12 cm de largo, obtusos, mayormente asimétricos, emarginados, bífidos, unidos hasta 14 cm en la base, los marginales de 35–40 cm de largo; el haz verde pálido, cubierto por escamas de cera, nervios relativamente gruesos y distantes de 0.7–1 mm; el envés plateado, densamente cubierto por una capa de pelos blancos aplicados con puntos minutos numerosos fuscos. Espádice recto con 9 espatas en el eje central, 80–85 cm de largo; inflorescencias parciales 4, de 25–30 cm de largo, espatas lanceoladas, densamente tomentosas en el margen y hacía el ápice en el envés por escamas largamente fimbriado-pelosas. Flores y frutos subsentados, pedicelos de 0.5–2 mm de largo, bracteolas lanceoladas, más largas que el pedicelo. Lóbulos del periantio 6, triangular-subulados, connados en la base; estambres 6–8;

ovario maduro obovado, comprimido. Frutos subsentados, deprimido-globosos de 11–13 mm de diámetro y 9–11 mm de largo. Semillas deprimido-globosas de 10 mm de diámetro y 9–11 mm de largo con 6 fisuras hasta la base; albumen ruminado, embrión basal.

Holótipo: O. MUÑIZ 15105; Cuba; Prov. Guántanamo (Baracoa) Arroyo Blanco al Oeste de Baracoa. Col.: BARBARA MUÑOZ y R. FLEITES, 19 de Febrero, 1978. HAC.

Observación: Especie afin a *C. rigida* (GRISEB. et WENDL.) BECC. la que se difiere de nuestra especie en tener hojas verdes en el envés sin puntos glanduliformes y frutos sentados de 7 por 9 mm de diámetro.

Coccothrinax camagüeyana BORHIDI et MUÑIZ **spec. nov.**

Palma 6–8 m alta; caudex cylindraceus, cca 17 cm in diametro. Vagina frondis oblongo-obovatus, 50–60 cm longus et 23–25 cm latus; pars libera late ovata, 15–20 cm longa, apice late rotundata vel truncata, fibris rigidis, apice dilatatis laxe intertexta, superne in acumina libera 1–3 cm longa et 1–2 mm lata excurrentibus. Petiolum 100–110 cm longum, pars libera 70 cm longa, basi 2–2,5 cm, apice usque ad 1,5 cm lata, viridis, parum vel non cerifera. Ligula duplicata; superior 3,2 cm longa, triangulari-acuta, lateraliter leviter revoluta; inferior triangulari-acuta, usque ad 1,5 cm longa. Lamina frondis semiorbicularis vel 3/4-orbicularis, segmenta 40–45; centralia 60–70 cm longa, basi usque ad 18 cm longe connata et 4,5 cm lata, acumine longe attenuata, 30–35 cm longa acuminata et acuta; nervis secundariis et tertiariis utrinque prominentibus supra pallide viridia, squamulis cerosis sparsis obtecta, subtus argentea, dense permanenterque albo-tomentosa, punctis glanduliformibus pallide ferrugineis dense dispositis suffulta.

Spadix usque ad 1 m longus, apice breviter incurvatus, dense spathiferus. Spathae late lanceolatae, apice acutae vel bifidae, coriaceae, rigide fibroso-nervosae, muricato-punctatae et tomentosae. Inflorescentiae partiales 8–9, rhachis dense tomentosa, posterior glabrescens, rami basales inflorescentiae abunde ramificatae. Pedicelli 3–4 mm longi, articulati in pedunculum 0,5–1 mm longum; bracteolae ovato-subulatae, 1–2 mm longe ad basim pedunculi adnatae. Lobi perianthii 6, stamina 9. Fructus orbicularis, subglobosus, vertice leviter compressus, 11 mm longus et 12–13 mm in diametro. Semina depresse globosa, 8–9 mm longa et 9–10 mm in diametro, 6-fissurata usque ad basem. Albumen ruminatum, embryo basalis.

Holotypus: O. MUÑIZ 15106; Cuba, Prov. Camagüey; Sierra de Cubitas. In silvis semideciduis basis meridionalis montis Cerro Tuabaquey. Leg.: A. BORHIDI et O. MUÑIZ, 28. oct. 1977. Holotypus: HAC Isotypus: BP.

Palma de 6–8 m de alto; tronco de unos 17 cm de diametro. Vaina de la hoja oblongo-obovada, 50–60 cm de largo por 23–25 cm de ancho, la parte libre anchamente aovada de 15–20 cm de largo, anchamente redondeada a truncada en el ápice, fibras rigidas, laxamente entretejidas ensanchadas hacia el ápice, puntas libres 1–3 cm de largo y 1–2 mm de ancho. Peciolo de 100–110 cm de largo, la parte libre 70 cm, 2–2.5 de ancho en la base y de hasta 1.5 cm de ancho en el ápice; verdoso y poco o no ceroso; ligula doble, la superior de 3.2 cm de largo, triangular-aguda, lateralmente poco revoluta, la inferior triangular-aguda de hasta 1.5 cm de largo. Limbo semiorbicular a 3/4-orbicular; segmentos 40–45, los centrales 65–70 cm de largo, hasta 18 cm connados en la base, y hasta 4.5 cm de ancho con punta muy larga-

mente estrechada de 30–35 cm de largo, acuminada y aguda; los nervios secundarios y terciarios prominentes en ambas caras; el haz verde pálido con escamas de cera esparcidas, el envés plateado, densa y permanentemente albo-tomentoso de pelos blancos aplicados y con puntos ferrugineo-pálidos glanduliformes densamente dispuestos en el envés.

Espádice de 1 m de largo, encorvado, muy densamente espatado con espatas anchamente lanceoladas, agudas y bifidas en el ápice, toscamente fibrosas, muricadas y tomentosas. Inflorescencias parciales 8–9; el ráquis densamente tomentoso, luego glabrescens, las ramitas basales abundantemente ramificadas. Flores y frutos pedicelados, pedicelo de 3–4 mm de largo, brácteolas aovado-subuladas de 1–2 mm de largo, con brácteolas aplicadas. Lóbulos del periantio 6, estambres 9. Frutos orbicular-subglobosos de 12–13 mm de diámetro y 11 mm de largo; semilla deprimido-globosa de 8–9 mm de largo y de 9–10 mm de diámetro. Albumen ruminado, embrión basal.

Holótipo: O. MUÑIZ 15106; Cuba, Prov. Camagüey; Sierra de Cubitas. En bosques semideciduos al pié Sur del Cerro Tuabaquey. Col.: A. BORHIDI e O. MUÑIZ, 28 de Octubre, 1977. HAC. Isótipo: BP.

Observación: Espécie afin a *C. gundlachii* LEÓN, la que se difiere de esta especie en tener fibras de la vaina de 3–4 mm de ancho con puntas libres de 4–6 cm de largo, hojas orbiculares con segmentos centrales de 90–100 de largo, puntos inconspicuos en el envés.

Coccothrinax elegans MUÑIZ et BORHIDI **spec. nov.**

Palma gracilis, usque ad 8–12 m alta; caudex cylindricus, 6–8 cm in diametro. Frondis vagina 35–40 cm longa, pars libera ovata, 8–10 cm longa, antice rotundata, fibris rigidis, 1–2 mm latis laxe intertextis, sine fibris liberis acutis suffulta. Petiolus 70–90 cm longus, basi 1,2–1,5 cm latus, supra medio usque ad 0,6–0,7 cm attenuatus, sub apice 0,8–0,9 cm latus, utrinque subaequaliter convexus. Ligula late ovata, 0,8 cm longa, apice rotundata vel subtruncata. Lamina frondis supra viridis, nitidula, subtus indumento argenteo et punctis glanduliformibus ellipticis parvis concoloribus dense obtecta, postremo glabrescens et punctis pallidis persistentibus praedita; segmenta 18–25, centralia 40–45 cm longa, basi usque ad 4–5 cm longe connata, apicem versus usque ad 3,5 cm dilatata, bis abrupte angustata, in acumina subulata 1–2 cm longa excurrentia, lateralia centralibus subaequilonga, 32–38 cm longa. Inflorescentiae interfoliares, nutantes et recurvatae. Spadix 40–60 cm longus, inflorescentiae partiales 1–4, plerumque 2–3, pars ramificata 10–12 cm longa, ramuli in 4–6 cm longe distantes, 10–15 cm longi. Bracteolae lanceolatae 0,8–1 mm longae, pedicelli 1–1,5 mm longi, 0,3–0,5 mm lati. Perianthium basi breviter connatum, lobi 6, filamentis ± aequilongi, basi filamentis aequilati, triangulares; stamina 6–7; filamenta basi breviter connata, quam perianthii dentes 1,5-plo longiora, antherae 1,5–2 mm longae. Ovarium globosum, stylus brevis, apice dilatatus. Fructus depresse globosus, 4–5 mm in diametro, pericarpium in sicco chartaceum, fragile; semina depresse globosa 3–4 mm in diametro, anguste 4-sulcata. Embryo apicalis.

Holotypus: 27933 SV; Cuba; Prov. Oriente (Prov. Santiago) Sierra Maestra; in mogotis calcareis ad Finca Demajagua pr. pag. Matías. Leg.: A. BORHIDI et O. MUÑIZ 23. oct. 1969. HAC. Isotypus: BP.

Specimina examinata: Cuba; Sierra Maestra, in mogotis calcareis ad Pozo Prieto supra rivum Rio Mogote, Matías; Leg.: A. BORHIDI et O. MUÑIZ 22. oct. 1969.

Palma delgada de hasta 8–12 m de alto. Tronco cilindrico de hasta 6–8 cm de diámetro. Vaina de la hoja de 35–40 cm de largo, la porción libre aovada, de 8–10 cm de largo, redondeada y entera en el ápice; fibras rígidas de 1–2 mm de ancho laxamente entretejidas. Pecíolo de 70–90 cm de largo, de 1.2–1.5 cm de ancho en la base estechandose hacía arriba sobre la mitad de hasta 0.6–0.7 cm de ancho, ± igualmente convexo en ambas caras. Ligula anchamente aovada de 0.8 cm de largo, redondeada a subtruncada en el ápice. Limbo de la hoja orbicular, verde oscuro y algo brillante en el haz, plateado en el envés con puntos glanduliformes elípticos y numerosos blancuzcos, finalmente glabrescente con puntos pálidos persistentes; segmentos 18–25, los centrales de 40–45 cm de largo, connados en la base en 4–5 cm de largo, ensanchados arriba hasta de 3.5 cm, el ápice dos veces estrechado, terminado en una punta subulada de 1–2 cm de largo; los segmentos laterales de 32–38 cm de largo.

Inflorescencias colgantes y encorvadas, espádice de 40–60 cm de largo, inflorescencias parciales 1–2, o mayormente 2–3, la parte ramificada de 10–12 cm de largo, ramitas floríferas apartadas en 4–6 cm, de 10–15 cm de largo. Bracteolas lanceoladas de 0.8–1 mm de largo; pedicelos de 1–1.5 mm de largo, 0.3–0.5 mm de ancho. Periantio brevemente connado en la base, lóbulos 6, poco mas cortos de los filamentos, ± igual anchos en la base como los filamentos. Estambres 6–7; filamentos brevemente connados, 1.5-veces tan largos como los lóbulos del periantio, anteras de 1.5–2 mm de largo. Ovario globoso, estilo corto, ensanchado en el ápice. Fruto deprimido-globoso de 4–5 mm de diámetro, pericarpio delgado, cartáceo, quebradizo; semillas deprimido-globosas de 3–4 mm de ancho, muy finamente 4-surcadas; embrión apical.

Holótipo: 27933 (SV) HAC; Cuba Prov. Santiago (Oriente), Sierra Maestra; Mogotes de caliza, Finca de Majagua, Matías. Col.: A. BORHIDI e O. MUÑIZ, 23 de Octubre, 1969. Isótipo: BP.

Una palma emergente de los mogotes de la Sierra Maestra, que con su tronco alto y delgado, tiene un aspecto y papel fitocenológico parecido, como la *Coccothrinax muricata* en las montañas calizas de Camagüey, pero morfológicamente (hojas y frutos) difiere mucho de esta ultima espécie. Es endémica de la zona de los mogotes del Norte de la Sierra Maestra.

Coccothrinax Leonis MUÑIZ et BORHIDI **spec. nov.**

Palma usque ad 8–10 m alta. Caudex cylindricus, 10–12 cm in diametro. Vagina frondis 35–40 cm longa, pars libera ovata, 6–8 cm longa, fibris rigidis, 1–2 mm latis dense intertexta, sine acuminibus liberis. Petiolus 60–120 cm longus, utrinque subaequaliter convexus, basi 1,3–1,8 cm sub apice ±1 cm latus. Ligula breviter triangularis, 1–1,5 mm longus, apice obtusus vel excisus. Lamina orbicularis, segmenta 28–36, centralia 32–55 cm longa, basi 4–10 cm longe connata, 3–3,6 cm lata, apice sensim 7–12 cm longe acuminata et acuta; supra viridis, nitidula, nervis secundariis leviter prominulis, subtus indumento albido praedita, nervis secundariis atque tertiariis leviter prominulis striata, epunctata. Inflorescentia ±45 cm longa, nutans, apicem versus recurvata, pars ramosa 7–10 cm longa, ramuli floriferi 4, ramosi,

10–14 cm longi, 1–3 cm longe distantes. Bracteae lanceolatae, 0,6–0,9 mm longae; flores sessiles, minuti, 1–1,5 mm in diametro. Perianthium basi breviter connatum, lobi 6, triangulari-subulati, usque ad 1 mm longi; stamina 6–7, tertio inferiore filamentorum connato, filamenta superne libera, 1–1,3 mm longa; antherae sagittiformes. Ovarium ovatum, sub anthesi 1–1,2 mm longum, stylus brevis, apice levissime vel non dilatatus, truncatus. Fructus sessilis vel subsessilis, 3–4 mm in diametro.

Semina depresse globosa, sulcis latis 5, radialiter et aequaliter dispositis 5-lobata, symmetrica. Embryo apicalis.

Holotypus: León 17362; Cuba; Prov. Oriente. In rupibus calcareis, pedis montis Sierra de Guaso, supra opp. Guantánamo. Leg.: H. León, oct. 1939 in floribus fructibusque; HAC. Isotypus: HAC.

Specimina examinata: León 19014. Prov. Oriente; Las Ninfas; Represa de Guaso, Guantánamo. Leg.: León et Marie-Victorin, febr. 1939.

Palma de hasta 8–10 m de altura. Tronco cilíndrico de hasta 10–12 cm de diámetro. Vaina de 35–40 cm de largo, porción libre aovada, de 6–8 cm de largo, las fibras rígidas, de 1–2 mm de ancho, densamente entretejidas, sin puntas libres. Peciolo de 60–120 cm de largo, ± igualmente convexo en ambas caras, 1.3–1.8 cm ancho en la base, ±1 cm de ancho en el ápice. Ligula triangular, breve, de 1–1.5 cm de largo, obtusa o excisa en el ápice. Limbo de la hoja orbicular, segmentos 28–36, los centrales de 32–55 cm de largo, unidos hasta 4–10 cm de largo, ensanchando por arriba hasta 3–3.6 cm, el ápice agudo, atenuado en una punta de 7–12 cm de largo; verde y algo brillante en el haz, los nervios secundarios poco prominulos, el envés cubierto de un indumento plateado, sin puntos aparentes, con nervios secundarios y terciarios prominentes. Espádice de ±45 cm de largo, colgante, encorvada en el ápice, la parte ramosa de 7–10 cm de largo, inflorescencias parciales 4, racemosas, de 10–14 cm de largo, distantes en 1–3 cm de largo. Brácteas de las flores lanceoladas, de 0.6–0.9 cm de largo; flores sentadas, diminutas de 1–1.5 mm de diámetro, el periantio brevemente connado en la base, lóbulos 6, triangular-subulados de hasta 1 mm de largo. Estambres 6–7, connados en su tercio inferior formando un tubo, la parte libre de los filamentos de 1–1.3 mm de largo, anteras aflechadas. Ovario aovado, de 1–1.5 mm de largo durante la floración, el estilo corto, muy poco u no ensanchado en el ápice, truncado. Fruto sentado o szbsentado de 3–4 mm de diámetro, deprimido globoso. Semilla con surcos anchos simmetricamente dispuestos formando una semilla claramente 5-lobulada. Embrión apical.

Holótipo: León 17362 HAC; Cuba, Prov. Guantánamo (Oriente), sobre rocas calizas de la Sierra de Guaso cerca de Guantánamo. Col.: León en Octubre de 1939. Isotipo: HAC.

Observación I.: Espécie perteneciente a la proximidad del grupo *Coccothrinax Miraguama* (HBK.) León sensu lato, pero difiere de ello en tener hojas permanentemente plateadas en el envés sin puntos, y frutos sentados.

Observación II.: Dedicada al honor del Hermano León (J. J. Sauget), gran explorador y mejor conocedor de las palmas cubanas.

Coccothrinax microphylla Borhidi et Muñiz **spec. nov.**

Palma 1–2 m alta; caudex cylindraceus, 4–8 cm in diametro. Vagina frondis oblongo-ovata, 20–25 cm longa, pars libera ovata, vel semiorbicularis, 5–6 cm longa, fibris tenuibus, 0,7–0,9 mm latis laxe intertexta, fibris ipsis apicem versus incrassatis in acumina libera 3–4

cm longa et 1 mm lata excurrentibus. Petiolum (sine pars vaginalis) usque ad 20 cm longum, tenue, basi 1 cm latum, apice 7 mm latum, albo-striatum. Ligula late triangulari-ovata, apice rotundata, 6–9 mm longa. Lamina folii 1/3-orbicularis, basi cuneata, rigide coriacea; segmenta 20–24, centralia 20–24 cm longa et 3 cm lata, basi 3–4 cm longe connata, apicem versus bis abrupte attenuata, apice ipso 4–5 cm longo, obtuso, lateralia 18–20 cm longa; supra pallide viridis, nervis obsoletis sine transversalibus, tomento albo-arachnoideo, mox deciduo obtecta, subtus argentea posterior glabrescens, pallide viridis, nervis obsoletis, punctis parvis ferrugineis dense dispositis suffulta.

Spadix axillaris, nutans, non recurvata; inflorescentiae partiales 2, spathae oblongo-lanceolatae, usque ad tertium inferiorem rhachidis excurrentes, pars ramificata 8–12 cm longa. Flores et fructus sessiles vel subsessiles. Bracteolae membranaceae, lobulis perianthii ± aequilongae. Perianthium 6-lobatum, lobi basi connati, membranacei, lanceolati, apice subulati. Stamina 6–8, filamenta basi connata, segmentis perianthii latiora et duplo longiora; antherae oblongo-sagittatae, 4–5 mm longae. Ovarium ovatum, superne attenuatum, stylus ovario aequilongus, stigmate infundibuliformi coronatus. Fructus globosus vel vertice leviter compressus, 6 mm longus et 7 mm in diametro. Semina 6-sulcata usque ad basem, depresse globosa, 5×6 mm. Albumen ruminatum.

Holotypus: O. Muñiz 15103; Cuba; Prov. Guantánamo (Oriente). In saxosis aridis calcareis declivibus occidentalibus montis Abra de Mariana, San Antonio del Sur. Leg.: Barbara Muñoz et R. Fleites, 17. febr. 1978. HAC

Palma de 1–2 m de alto; tronco delgado, de 4–8 cm de diámetro. Vaina oblongo-aovada de 20–25 cm de largo, la porción libre aovado a semiorbicular de 5–6 cm de largo; fibras delgadas laxamente entretejidas, ligeramente engrosadas hacia el ápice, terminando en puntas libres de 3–4 cm de largo y 1 mm de ancho. Peciolo (sin vaina) de hasta 20 cm de largo, delgado, de 1 cm de ancho en la base y 7 mm en el ápice, estriado blancuzco. Ligula anchamente triangular-aovada, redondeada en el ápice de 6 a 9 mm de largo. Lámina de la hoja rigida, coriácea, 1/3-orbicular, cuneada en la base, de 20–24 segmentos; segmento central de 20 a 24 cm de largo y 3 cm de ancho, unido hasta 3–4 cm, dos veces abruptamente estrechados en una punta de 4–5 cm de largo; segmentos laterales de 18–20 cm; el haz verde pálido con nervios longitudinales poco acentuados, sin trazas de nervios transversales, provistos de un tomento formado por pelos blancos, finos y caedizos; el envés plateado por pelos blancos, luego glabrescentes, nervios obsoletos, densamente punteados por puntos ferrugineos pequenos.

Espádice axilar, colgante, no encorvado; inflorescencias parciales 2, espatas oblongo-lanceoladas, llegan hasta el tercio inferior del raquis de las ramitas floríferas, estas de 8–12 cm de largo. Flores y frutos sentados a subsentados; segmentos del periantio 6, lanceolados, subulados; estambres 6–8, filamentos connados en la base, más anchos que los segmentos del periantio y dos veces más largos; anteras oblongo-aflechadas de 4–5 mm; ovario aovado, atenuado arriba, liso. Estigma embudado, poco más largo que el ovario. Fruto globoso a subgloboso 6×7 mm; semillas deprimido globosas con 6 surcos hasta la base; el albumen ruminado.

Holótipo: O. Muñiz 15103; Cuba; prov. Guantánamo (Oriente). En rocas calizas áridas ladera oeste del Abra de Mariana, San Antonio del Sur. Col.: Barbara Muñoz y R. Fleites, 17. febrero, 1978. HAC

Observación: Espécie afin a *Coccothrinax moaensis* (Borhidi et Muñiz) Muñiz, pero se difiere de ella en tener vainas con puntas libres, hojas 1/3-orbiculares, cuneadas en la base, flores y frutos sentados y 6 a 8 estambres.

Coccothrinax nipensis Borhidi et Muñiz **spec. nov.**

Palma 2–3 m alta. Truncus 5–8 cm in diametro. Vagina flavo-brunnea, clara, pars libera oblongo-ovata, 9–11 cm longa antice rotundata, fibris dense intertextis apicem versus valde incrassatis lignosis 3,5–4,5 mm latis, in apicibus liberis obtusis 5–7 cm longis protractis suffulta. Petiolum 45–60 cm longum, pars libera (sine vagina) 40–50 cm longa, basi 9 mm, apicem versus 6 mm lata, biconvexa, levissime vel non cerosa, viridis. Ligula rigida, rotundata vel truncata 1–1,2 cm longa. Lamina frondis rigida, 3/4-orbicularis, segmenta 16–20, centralia 35–38 cm longa, usque ad 3 cm lata, basi 3–4 cm longe connata, apicem versus levissime attenuata, apice ipso acuto abrupte contracto, 3–4 cm longo suffulta, lateralia 22–25 cm longa, omnia supra viridia et leviter nitida, subtus colore simillima, paullo opaciora, nervis secundariis atque tertiariis utrinque obsoletis et vix distinctis, lamina utrinque glabra et subtus punctis fuscis parvis sparse obtecta.

Inflorescentiae adscendentes, rectae, 40–55 cm longae, spathae subcoriaceae, nervosae, apicem versus tomentosae. Inflorescentiae partiales 2–3, rectae, pedunculi exserti, pars ramificata 7–12 cm longa, ramuli floriferi inferiores 4–5 cm longi, bracteis triangulari-acuminatis 3–5-nervis, 3–4 mm longis praediti. Flores sessiles vel subsessiles, pedicelli usque ad 0,5 mm longi, bracteolae lanceolatae, usque ad 1,5 mm longae. Perianthii segmenta 6, lineari-subulata, basi ipsa brevissime connata; stamina 7–8, filamenta usque ad 1/3–1/2 longitudinis connata, cupuliformia, quam lobis perianthii 4–5-plo longiora et 4–5-plo latiora. Ovarium ovatum, antice satis longe attenuatum, stylus brevior. Fructus globosus 7 mm longus et latus, pericarpium tenue. Semen depresso-globosum, 4 mm longum et 5 mm latum, 5–6-segmentatum. Embryo apicalis.

Holotypus: Alain 7785; Cuba, Prov. Holguin, Sierra de Nipe, in charrascales de la Loma Bandera, Mayari. Leg.: Alain, Acuña et Ramos, 19. abril 1960. HAC.

Specimina examinata: Cuba, Prov. Holguin, Sierra de Nipe al pie de la Loma Mensura, en charrascales, cca. 750 m.s.n.m. Pinares de Mayari. Leg.: A. Borhidi et O. Muñiz 18. 7. 1970.

Palma de 2–3 m de alto. Tronco de 5–8 cm de diámetro. Vaina amarillento-parda, el borde libre de 9–11 cm de largo, alargado-aovado, fibras densamente entretejidas ensanchadas hacía el ápice y terminadas en puntas libres leñosas y obtusas de 5–7 cm de largo y 3.5–4.5 mm de ancho. Peciolo de 45–60 cm de largo, la parte libre (sin vaina) de 40–50 cm de largo, biconvexo, 9 mm de ancho en la base y 6 mm de ancho hacía el ápice, no ceroso, verde. Ligula rígida, redondeada a truncada, de 1.0–1.2 cm de largo. Limbo 3/4-orbicular, rigido, de 16–20 segmentos, los centrales de 35–38 cm delargo, de hasta 3 cm de ancho, unidos en 3–4 cm de la base, bruscamente contraidos hacía el ápice en una punta de 3–4 cm de largo, aguda, verdes y brillantes arriba, iguales o muy poco pálidas en el envés, con puntos fuscos diminutos y escasos. Nervios longitudinales secundarios y terciarios poco visibles y distinguibles en ambas caras, nervios transversales nulos.

Espádices ascendentes rectos, de 40–55 cm de largo, con 2–3 inflorescencias parciales. Espatas subcoriaceas, nervosas, tomentosas en el ápice. Pedunculos exertos, la parte ramificada de 7–12 cm de largo, de contorno aovado, ramitas fructiferas inferiores de 4–5 cm de largo, con bráctea triangular-acuminada 3–5-nervada de 3–4 mm de largo. Flores sésiles o subsentadas, pedicelos de hasta 0.5 mm de largo, bracteolas lanceoladas, de hasta 1.5 mm de largo. Periantio muy brevemente cupuliforme, lóbulos 6, lineal-subulados; estambres

7–(–8), los filamentos connados de hasta el 1/3–1/2 de su longitud, cupuliformes, 4–5-veces más largos y mas anchos que los lóbulos del periantio. Anteras oblongo-elípticas, de 2–2.5 mm de largo. Ovario aovado, atenuado arriba en el estilo más corto que el ovario. Fruto globoso, de 7×7 mm cuando seco; pericarpio delgado. Semilla de 4×5 mm deprimido globosa, dividida en 5–6 segmentos principales. Embrión apical.

Holótipo: ALAIN 7785 HAC; Cuba, Prov. Holguin, Sierra de Nipe; charrascales de la Loma Bandera Mayari. Col.: ALAIN, ACUÑA y RAMOS, 19 de Abril, 1960.

Observación: Especie afin a *C. pseudorigida* LEÓN, la que se difiere de nuestra especie en tener segmentos de hojas lustrosos y revolutos, puntos pálidos en el envés, flores y frutos pedicelados.

Coccothrinax yunquensis BORHIDI et MUÑIZ **spec. nov.**

Palma 4–8 m alta; caudex cylindraceus, 8–10 cm crassus. Frondis vagina 25–30 cm longa, pars libera 10–15 cm longa, late ovata vel truncata, fibris rigidis superne incrassatis, usque ad 3–4 mm latis in apicibus liberis acutis, 3–5 cm longis protractis suffulta. Petiolum 110–120 cm longum, pars libera (sine vagina) 80–90 cm longa, basi 1,5 cm, sub apice 1,2 cm, apice 1,8 cm lata superne valde dilatata, biconvexa, longitudinaliter striata, levissime cerosa, viridis. Ligula 1,2–1,8 cm longa deltoidea vel subtrilobata, apice acuta vel truncata, lateraliter compressa et recurva. Lamina frondis rigida, 3/4-orbicularis; segmenta 38–42, centralia apicem versus levissime attenuata, apice ipso acuto vel obtuso vel breviter acutato 10–12 cm longo suffulta, lateralia 22–24 cm longa, omnia supra viridia, nitida, subtus pallide cinerea vel albida postremo concoloria nervis secundariis atque tertiariis utrinque dense dispositis, punctis glanduliformibus parvis, ferrugineis vel fuscis satis dense obtecta.

Inflorescentiae recurvatae, axillares, breves, usque ad 30–40 cm longae; spathae pergamaceae, valde nervosae, apicem versus tuberculato-punctulatae, apice ipso bifido, barbatae. Inflorescentiae partiales 2–3, cernuae, ramuli floriferi 3–5 cm longi, basi 0,7–1,5 mm lati, bracteis lanceolatis, uninervibus 3–4 mm longis suffulti. Pedicelli 0,2–1 mm longi, bracteolae subulatae, aequilongae vel pedicellis longiores. Perianthii segmenta 6, linearia, basi ipso brevissime connata; stamina 6–7, filamenta libera quasi usque ad basem, quam lobis perianthii 2–3-plo longiora et 3–4-plo latiora; ovarium globosum, stylus basi leviter attenuatus, apice, manifeste ampliatus, ovario ± aequilongus. Fructus maturus non visus.

Holotypus: BORHIDI 15279; Cuba, Prov. Guantánamo. In saxosis calcareis humidis cacuminis montis Yunque de Baracoa, 500 m alt. s.m. prope opp. Baracoa. Leg.: A. BORHIDI et P. HERRERA, 26. nov. 1978. HAC; isotypus: BP.

Palma de 4–8 m de altura, tronco cilindrico de 8–10 cm de diámetro; vaina de 25–30 cm de largo, la parte libre de 10–15 cm de largo, anchamente aovada vel truncado, compuesta de fibras rígidas engrosadas hacia arriba hasta 3–4 mm de ancho terminando en puntas libres agudas de 3–5 cm de largo. Pecíolo de 110–120 cm de largo, la parte libre 80–90 cm; 1.5 cm de ancho en la base, la parte más delgada 1.2 cm, ensanchando notablemente en el ápice hasta 1.8 cm, sección biconvexa, superficie tenuemente estriada, ligeramente cerosa,

verde. Lígula de 1.2–1.8 cm de largo, deltoidea a subtrilobada, el ápice agudo a truncado, lateralmente comprimido y encorvado. Lámina 3/4-orbicular, rígida, segmentos 38–42, los centrales de 42–45 cm de largo por unos 4.5 cm de ancho, connados en la base en 13–16 cm de largo, agudo a obtuso, los laterales de 22–24 cm de largo el haz verde el envés grisáceo-tomentoso con pelos apretados y con puntos glanduliformes pequeños ferrugineos a fuscos; nervios secundarios y terciarios densos y prominentes en el haz, obsoletos en el envés.

Inflorescencias axilares, encorvadas, de hasta 30 cm de largo; espatas pergamaceas muy nervosas, tuberculado-puntuladas hacia el ápice bífido y barbudo. Inflorescencias parciales 2–3, colgantes, ramitas floríferas de 3–5 cm de largo y de 0.7–1.5 mm de ancho en la base; brácteas lanceoladas uninervias de 3–4 mm de largo, pedicelos de 0.2–1 mm de largo, bracteolas subuladas, igualmente o más largas que el pedicelo. Segmentos del periantio 6, lineales muy brevemente connados en la base; estambres 6–7, filamentos libres casi hasta la base, 2–3 veces más largos que los segmentos del periantio y 3–4-veces más anchos en la base. Ovario globoso, estilo de igual largo que el ovario ligeramente atenuado en la base, ensanchado en el ápice. Fruto maduro no visto.

Holótipo: BORHIDI 15279; Cuba, Prov. Guantánamo. Paredones humedos de caliza de la cumbre del Yunque de Baracoa. Col.: A. BORHIDI e P. HERRERA; 26. noviembre 1978.

Observación: Afin a *C. Salvatoris* LEÓN, la que difiere de esta espécie, teniendo fibras de vaina de 4–9 mm de ancho obtusas en el ápice, segmentos de la hoja más cortos y anchos con puntos glanduliformes grandes y pálidos en el envés, inflorescencias parciales más grandes, flores con pedicelos de 1–2.5 mm de largo, estambres 7–9 y filamentos connados hasta la mitad formando una cúpula.

Coccothrinax crinita (GRISEB. et WENDL.) BECC.

Esta espécie se encuentra en dos grupos de poblaciones geográficamente distantes y aisladas, que presentan dos subespécies:

ssp. **crinita**

fibris liberis vaginae parte intertexta aequilongis vel multo longioribus, undulatis, foliis subtus nitidis, glabris, glandulis acutis ferrugineisque dense obsitis.

fibras libres capiliformes igual largas o mas que la parte entretejida de la vaina. Las hojas brillantes, glabras en el envés con puntos glanduliformes ferrugineos densos.

Prov. Pinar del Rio; En una cañada cerca de las Pozas, sobre serpentina.

ssp. **brevicrinis** BORHIDI et MUÑIZ **ssp. nova**

fibris liberis vaginae parte intertexta multo brevioribus, rectis vel recurvatis non undulatis, foliis subtus pallide ferrugineis adpresse tomentulosis, postremo glabrescentibus, glandulis albis sub indumento obsoletis a typo clare differt.

Difiere del tipo en tener fibras libres capiliformes mucho mas cortas que la parte entretejida de la vaina, estas son rectas o encorvadas, no onduladas. Las hojas mates en el envés cubiertas por un indumento ferruginoso, tomentoso, luego glabrescente: puntos glanduliformes blancos, poco conspicuos.

Holotypus: JACK 7963; Prov. Cienfuegos: Sierra de Escambray, San Juan de Ullóa, San Blas, cerca de La Sierra entre 200–300 m de alt. 26. 4. 1940. HAC!

Ejemplares examinados: LEÓN 14033; Prov. Cienfuegos; Lomas de Trinidad, Buenos Aires; 12. 7. 1929. — LEÓN 16170; Prov. Cienfuegos; Guajimico, al Sur de las montañas de Trinidad. Col.: F. GAMBOA y R. NIN; sept. 1934.

Ambas subespécies crecen en suelos de serpentinas, pero mientras la ssp. *crinita* es un taxon de las llanuras, terrenos bajos, estacionalmente inundados, la ssp. *brevicrinis* vive en las alturas medianas y en la zona colinosa de la montaña representando un ecótipo distinto. Sus condiciones fitocenológicas no han sido estudiadas.

Coccothrinax cupularis (LEÓN) MUÑIZ et BORHIDI **status novus**

(Basionymon: *Coccothrinax miragrama* (HBK) LEÓN var. *cupularis* LEÓN Mem. Soc. Cub. Hist. Nat. **13:** 117. 1939)

Palma de 8–15 m de alto. Tronco cilindrico de hasta 8–12 cm de diámetro. Vaina de la hoja con fibras densamente entretejidas, de 1–2 mm de ancho, rigidas, la porción libre aovada y comunmente bifida en el ápice. Pecíolo de 14–20 mm de ancho en la base y de 10–12 mm de ancho en el ápice. Lígula leñosa, delgada, muy brevemente 3-lobulada a subtruncada, erguida. Limbo 1/3–3/4-orbicular, segmentos 30–36, los centrales de 45–55 cm de largo, unidos en 12–15 cm de la base, el ápice abruptamente adelgazado, con una punta aguda de 1–3 cm de largo, verdes y nitídulas en el haz, plateadas en el envés con puntos glanduliformes pálidos a blancuzcos numerosos en el envés; nervios secundarios y terciarios promínulos en ambas caras. Inflorescencias parciales 3–4, ramitas floríferas inferiores de 8–10 cm de largo, brácteas de 1–2 mm de largo, pedicelos de 2–4 mm de largo. Lóbulos del periantio 6, muy estrechos, lineal-subulados, de mitad de la longitud de los filamentos, estos 12, unidos hasta la mitad de su longitud, formando una cupula, estilo delgado y 2–3-veces mas corto del ovario subgloboso. Fruto globoso, liso, de $5–6 \times 7–8$ mm de diámetro, pericarpio chartáceo, delgado, semilla negra de 3.5×5 mm de diámetro, anchamente 5-surcada; embrión apical.

Coccothrinax guantanamensis (LEÓN) MUÑIZ et BORHIDI **status novus**

(Basionymon: *Coccothtrinax argentea* LODD. var. *guantanamensis* LEÓN in Mem. Soc. Cub. Hist. Nat. **13:** 135. 1939; — *C. argentea* ssp. *guantanamensis* BORHIDI et MUÑIZ Bot. Közlem. *58:* 176. 1971)

Palma 6–8 m alta; vagina frondis ± 35 cm longa et 12 cm lata, pars libera valde abbreviata, truncata et irregulariter incisa, fibris coriaceis 0,1–0,5 mm latis dense intertexta inferne compacta. Petiolum $\pm$ cm longum, pars libera sine vagina cca 55 cm longa,

basi 2,5 cm latum, sub apice 1,3 cm, apice 2,3 cm latum. Ligula late triangularis, lateraliter compressa et revoluta, apice acuta. Lamina frondis 3/4-orbicularis, segmenta 40–62, centralia 60–80 cm longa et 2,3–3,4 cm lata, 15–18 cm longe connata, longe attenuata, apice bifida 6–12 cm longa, basalia cca 30–40 cm longa; nervis secundaris supra conspicuis, subtus prominentibus, transversalibus nullis, subtus albotomentosa postremo glabra, epunctata. Inflorescentiae axillares, usque at 1,05 m longae, inflorescentiae partiales 4–8, spathae lanceolatae, plerumque breviter bifidae, apice fibrosae et glabrae. Flores subsessiles vel 0,5–3 mm longe pedicellatae, bracteolae lanceolatae, 2–3 mm longae. Lobi perianthii 6, triangulari-subulati, basi breviter connati, rariter cupulam brevem formati. Stamina 9–10, subulata, lobis perianthii aequilati vel augustiores. Ovarium ovatum vel subglobosum. Fractus globosus, 9–11 mm in diam.; semina subglobosa, 6–10 mm in diametro, profunde 4–6-sulcata usque ad basem. Embryo apicalis.

Palma 6–8 de altura. Vaina de la hoja con apice truncado, irregularmente inciso, unos 35 cm de largo y hasta 12 cm de ancho, parte libre muy corta, truncada, formada por fibras de 0.1–0.5 mm de ancho, formando una lámina compacta y coriacea en sus partes intermedia y basal. Peciolo de unos 85 cm de largo, parte libre de unos 55 cm de largo, 2.5 cm de ancho en la base, la parte más estrecha 1.3 cm y 2.3 cm en el ápice. Ligula anchamente triangular, aguda en el ápice, lateralmente algo revoluta. Limbo 3/4-orbicular, segmentos 40–62, los centrales 60–80 cm de largo y 2.3–3.4 cm ancho, connados en 15–18 cm, adelgazándose en la punta largamente atenuada, bifida de 6–12 cm de largo, los segmentos marginales aproximadamente 1/2 de largo que los centrales; nervios secundarios prominulos o conspicuos en el haz y prominulos en el envés; nervios transversales nulos. El haz verde brillante, el envés cubierto por un tomento fino finalmente caedizo; puntos ausentes. Espádices de haste 105 cm de largo, inflorescencias parciales de 4–8, espatas lanceoladas, mayormente corto-bifidas en el ápice, mayormente glabras, fibrosas; flores subsentadas a pediceladas, pedicelos de 0.5–3 mm de largo, con bracteolas lanceoladas de 2–3 mm de largo. Lóbulos del periantio 6, triangular-subulados, brevemente connados en la base, a veces formando una cupula. Estambres 9–10, subulados; igual e poco más estrechos que los segmentos del periantio; ovario aovado a subgloboso; fruto globoso de 9–11 mm de diámetro, semilla subglobosa de 6 a 10 mm de diámetro, surcos 4–6, profundos hasta cerca de la base, endospermio ruminado, embrión apical.

Observación: Esta especie no pertenece a *Coccothrinax argentea* LODD. la que se distingue por tener vainas de ápice oblongo-aovadas y hojas con nervios transversales visibles.

Coccothrinax macroglossa (LEÓN) MUÑIZ et BORHIDI **status novus**

(Basionymon: *Coccothrinax miragrama* (HBK.) BECC. var. *macroglossa* LEÓN Mem. Soc. Cub. Hist. Nat. **13:** 118. 1939)

Palma robusta de 8–12 m de alto; el tronco cilindrico, de 10–12 cm de diámetro. Vaina de 30–50 cm de largo, de fibras subrigidas ± densamente entretejidas, porción libre de la vaina aovada a oblonga, de 10–25 cm de largo, de fibras de 1–2 mm de ancho, comunmente con puntas delgadas, libres de 1–3 cm de largo, quebradizas, a veces rigidulas. Peciolo de hasta 2 cm de ancho en el ápice. Ligula triangular, robusta, de 2–3.5 cm de largo, mayormente aguda. Limbo de la hoja orbicular, undulado, de 40–50 segmentos; los centrales de hasta 80 cm de largo, unidos en 15–20 cm de largo en la base, ensanchandose hacia arriba hasta 3.5–5 cm de ancho, paulatinamente atenuados en una punta muy alargada, aguda; poco brillantes arriba, plateados en el envés, nervios secundarios y terciarios prominulos en ambas caras, puntos glanduliformes prominentes numerosos en el envés. Espatas de hasta

3–4 cm de ancho, albo-tomentosas hacia el ápice. Inflorescencias parciales 3–4, ramitas fructiferas de hasta 4 mm de ancho en la base, de 10–12 cm de largo, a veces las ramitas inferiores se ramifican de nuevo en 8–10 rámulos. Lóbulos del periantio 6, brevemente connados en la base, oblongo triangulares a lineari-oblongos abruptamente estrechandose de una base ancha, agudas en el ápice, de 1.2–1.5 mm de largo. Estambres 6–8, filamentos connados en un tubo de 0.5–0.7 mm de ancho, 1.5–2 mm de ancho, la base de igual ancho como la base de los lóbulos del periantio, subulados; anteras aflechadas, de 1.8–2.2 mm de largo. Ovario aovado a subgloboso de 1–1.2 mm de largo, liso el estilo de 1.2–1.5 mm de largo, muy ensanchado en el ápice, estigma claramente 6-lobulado. Fruto maduro negro, de 10–12 mm de diámetro, pericarpio jugoso, algo amargo. Semilla negra, deprimido-globosa, de 5–7×7–8 mm de diámetro, anchamente surcada hasta la base. Embrión apical a subapical.

Esta espécie, aunque este relacionada estrechamente a *Coccothrinax Miraguama* (HBK.) León se distingue bien por su vaina con puntas libres, por la forma de los segmentos de la hoja, por las flores brevemente pediceladas con pedicelos de 1–2 mm de largo, por la forma de los lóbulos del periantio, numero de estambres y por el tamaño, color y forma de las semillas.

Esta distribuida en la llanura de Noreste de la Provincia Camagüey, en la llanura de Norte de la Provincia Victoria de las Tunas y en la llanura de la Provincia Holguin. Endémica de Cuba Centro-Oriental.

Coccothrinax moaensis (Borhidi et Muñiz) Muñiz **status novus**

(Basionymon: *Coccothrinax yuraguana* (A. Rich.) León ssp. *moaënsis* Borhidi et Muñiz Acta Bot. Acad. Sci. Hung. **17:** 1. 1971)

Palma de 2–4 m de alto. Tronco cilindrico de hasta 8 cm de diámetro. Vaina de la hoja flexuosa, la porción libre de 4–5 cm de largo, subtruncada, emarginada o excisa, las fibras delgadas, densamente entretejidas, de hasta 1 mm de ancho. Peciolo de 30–35 cm de largo, y de 7–8 mm de ancho en la base. Limbo de la hoja oblicular, rigida, verde oscuro en el haz, plateado en el envés con puntos glanduliformes pálidos; segmentos de 18–22, los centrales de 22–25 cm de largo, muy apartados, en 2–3 cm connados en la base, el ápice corto, redondeado. Ligula de 6–7 mm de largo, redondeada a truncada. Inflorescencia colgante y encorvada, de 20–25 cm de largo, ramitas fructiferas de hasta 3 cm de largo. Pedicelos de 1–1.5 mm de largo, estambres 9. Fruto de 6–7 mm de diámetro, deprimido-globoso; pericarpio delgado. Semilla de 5–6 mm de diámetro, estrechamente surcado.

Esta espécie esta relacionada estrechamente a la espécie siguiente de la cual se difiere por su vaina mas delgada y flexible, por los numeros de los segmentos e indumento de las hojas, además por el numero de los estambres.

Esta distribuida en los latosoles erosionados poco profundos de las mesetas altas o sobre mocarreros de latosoles extramadamente pobres en nutrientes en matorrales siempreverdes, de la Sierra de Moa.

Coccothrinax orientalis (León) Muñiz et Borhidi **status novus**

(Basionymon: *Coccothrinax yuraguana* (A. Rich.) León var. *orientalis* León Mem. Soc. Cub. Hist. Nat. **13:** 121. 1939)

Palma de hasta 8–12 m de alto. Vaina de la hoja de fibras rigidas de 1–2 mm de ancho, densamente entretejidas, la parte libre de 3–4 cm de largo, el borde entero, sin puntas libres. Ligula de 12 mm de largo, redondeada en el ápice. Peciolo de 1.8 cm de ancho en la base y 9–10 mm de ancho bajo del ápice. Limbo de la hoja orbicular de 30–36 segmentos, los centrales de 25–35 cm de largo, unidos en 4–8 cm de largo en la base, ensanchandose hacia arriba de hasta 4.5 cm de ancho, la punta de 4–5 cm de largo, ancha y redondeada en el ápice, verdes en el haz, poco plateados en el envés, finalmente lampiños y pálidoverdosos, con puntos fuscos pequeños numerosos. Espádices de 3–4 inflorescencias parciales, las espatas lampiñas, brevemente acuminadas. Ramitas fructíferas interiores con bráctea triangular de 3 mm de largo. Segmentos del periantio estrechos. Filamentos 6–7, unidos en la base ensanchada 2–3-veces tan largos como los lóbulos del periantio. Fruto de 7–8 × 6–7 mm de diámetro, deprimido-globoso; pericarpio delgado. Semilla deprimido-globosa de 5 × 6 mm de diámetro, de color pardo oscuro, estrechamente surcada. Embrión apical.

Esta espécie, aunque este relacionada estrechamente a la *Coccothrinax Yuraguana* (A. RICH.) LEÓN se distingue bien por su vaina mas rígida, por los segmentos e indumento de la hoja y por el número de los estambres.

Esta distribuida en los pinares y a veces en los charrascales (matorrales siempreverdes de serpentina) de todas las montañas del Norte de Oriente: Sierra de Nipe, Sierra del Cristal y de Mícara, Sierra de Moa, Cuchillas de Baracoa. Un ejemplar de SHAFER 2827 de la Loma de los Hornos, Cayo Guayaba, Prov. Camagüey, pertenece con duda a esta espécie.

Coccothrinax savannarum (LEÓN) BORHIDI et MUÑIZ **status novus**

(Basionymon: *Coccothrinax muricata* LEÓN var. *savannarum* LEÓN in Mem. Soc. Cub. Hist. Nat. **13:** 130. 1939)

Palma usque ad 10–12 m alta. Vagina frondis flavo-brunnea, clara, pars libera oblongo-ovata, 5–9 cm longa, apice late rotundata vel plerumque truncata, fibris dense intertextis apicem versus leviter incrassatis lignosis, 1,5–2 mm latis, in apicibus liberis acutis 2–4 cm longis protractis suffulta. Petiolum biconvexum, supra longitudinaliter manifeste nervoso-striatum, utrinque lucidum, basi 15 mm, sub apice 10 mm latum. Ligula rigida, semiorbicularis, rotundata, leviter obliqua, 1,5 cm longa. Lamina frondis rigida, 3/4-orbicularis, segmenta 30–35, centralia 28–32 cm longa, 3,5–4 cm lata, basi usque ad 5,5 cm longe connata, apicem versus aequilata vel levissime attenuata, apice ipso triangulari 5,5–6,5 cm longo abrupte contracto, breviter acuto vel obtuso; lateralia 18–19 cm longa, omnia supra obscure viridia, subtus paullo pallidiora, nervis secundariis atque tertiariis utrinque bene distinctis, lamina supra nitida, subtus indumento leviter ferrugineo satis dense obtecta et punctis ellipticis prominentibus ferrugineis dense dispositis praedita.

Inflorescentiae adscendentes, rectae, 75–85 cm longae; spathae 6, subcoriaceae, nervosae, apicem versus tomentosae. Inflorescentiae partiales 2, 22–25 cm longae, rectae vel leviter undulatae, pedunculi exserti; pars ramificata 15–20 cm longa, ramuli floriferi 32–40, inferiores 7–8 cm longi, bracteis deciduis. Pedicelli 1–2,5 mm longi, perianthii segmenta 6, triangulari-subulata; stamina 6–7, filamenta basi brevissime connata. Fructus non pleno maturus depresse globosus, 5 × 6 cm in diametro, dense brevissimeque muricato-punctulatus, nitidus. Semina profunde 5-partita, 4 mm in diametro.

Holotypus: LEÓN 15910. Prov. Oriente, Sierra de Nipe, Sabana Risueña, Bayate de Miranda. Leg.: V. HELD et O. HEIMER, jan. 1933. HAC!, isotypus: HAC.

Obs.: Spadicis rectis non *C. murictae* LEÓN affinis sed inter *C. pauciramosam* BURRET et *C. nipensem* BORHIDI et MUÑIZ ponenda. Prima a planta nostra petiolis tenuibus, segmentis foliorum 15–20, inflorescentia pauciramosa, secunda fibris vaginae duplo latioribus, segmentis foliorum 16–20, floribus sessilibus differt.

Palma de 10–12 m de alto. Vaina amarillo-castaña, la parte libre alargado-aovada de 5–9 m de largo, anchamente redondeada o comunmente truncada en el ápice. Las fibras densamente entretejidas, que se ensanchan arriba hasta 1.5–2 mm de ancho, adelgazandose en el extremo en puntas libres agudas y acuminadas de 2–4 cm de largo. Peciolo biconvexo de 1.5 cm de ancho en la base y 1 cm de grueso debajo del ápice; estriado-venoso en ambas caras, lustrosas. Ligula rigida, semiorbicular, redondeada en el ápice, poco oblicua en la base, 1.5 cm de largo. Limbo 3/4-orbicular verde-brillante en el haz, ferrugineo-pálido en el envés. Segmentos de 30–35. los centrales de 28–32 cm de largo, 3.5–4 cm de ancho, connados en la base hasta de 5.5 cm de largo, con bordes paralelos en la parte media adelgazandose bruscamente en una punta triangular de 5.5–6.5 cm de largo, aguda u obtusa en el ápice; los laterales de 18–19 cm de largo, todas finamente estriadas en ambas caras por los nervios longitudinales numerosos y poco salientes; el envés cubierto por un indumento ferruginoso con puntos ferruginosos prominulos densos.

Espádice recto, de 75–85 cm de largo; espatas 6, subcoriaceas, tomentosas en el ápice. Inflorescencias 2, rectas, de 22–25 cm de largo, la parte ramificada de 15–20 cm, ramitas floriferas 32–40, las inferiores de 7–8 cm de largo. Pedicelos fructiferos de 1–2.5 mm de largo, segmentos del periantio 6, triangular-subulados. Estambres 6–7, filamentos muy brevemente connados en la base. Fruto no completamente maduro deprimido globoso de 5×6 cm de diámetro, muricado-punteado, brillante. Semilla profundamente 5-partida de 4 mm de diámetro. Embrión apical.

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Acta Botanica Academiae Scientiarum Hungaricae, Vol. 27 (3—4), pp. 455—460 (1981)

THE RAREST INTERSPECIFIC POLYSTICHUM HYBRID, P. × LONCHITIFORME (HALÁCSY) BECHERER (= P. LONCHITIS × P. SETIFERUM) FOUND IN HUNGARY

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(Received: March 1, 1981)

A hybrid *Polystichum* has been collected in Hungary, and tentatively identified as *P.* × *illyricum*. The mitotic chromosome count, however indicated a diploid level, 2n = 82. During meiosis about 40 univalents and 21 bivalents were found. Accordingly, the hybrid is a diploid combination of *P. lonchitis* × *P. setiferum* (= *P.* × *lonchitiforme*), new for the Hungarian Flora.

Introduction

The genus *Polystichum* in Europe as well as in Hungary is represented by four distinct species as follows: *P. setiferum* (FORSKAL) WOYNAR, *P. lonchitis* (L.) ROTH, *P. aculeatum* (L.) ROTH and *P. braunii* (SPENNER) FÉE. All the six possible hybrids have already been reported in Europe occurring sporadically in mixed populations of the species: *P.* × *lonchitiforme* (HALÁCSY) BECHERER, *P.* × *illyricum* (BORBÁS) HAHNE, *P.* × *bicknellii* (CHRIST.) HAHNE, *P.* × *eberlei* MEYER and *P.* × *luerssenii* (DÖRFLER) HAHNE (MEYER 1960, MANTON and REICHSTEIN 1961) [the new name of *P.* × *eberlei* MEYER is *P.* × *meyeri* SLEEP et REICHST. (SLEEP and REICHSTEIN 1967)]. The genus in Hungary has been studied cytologically by VIDA (1965, 1966, 1973) as well as VIDA and REICHSTEIN (1975).

P. setiferum and particularly *P. aculeatum* are not uncommon in rather humid forests of the hilly areas of Hungary, while *P. lonchitis* and *P. braunii* are rarities in our country (SOÓ 1964, VIDA 1966). Accordingly, only *P.* × *bicknellii* (*P. aculeatum* × *P. setiferum*) could be expected to occur with considerable probability. Actually, out of the six possible combinations already listed three of them have been found in Hungary, too. Their hybrid nature (*P.* × *bicknellii*, *P.* × *illyricum*, *P.* × *luerssenii*) were supported by cytological analyses of chromosome number, behaviour and spore formation by VIDA (1966). His conclusions strengthened MANTON's earlier suggestions on genomic relationships of the four species concerned (Fig. 1).

Because only a few exemplar of *P. lonchitis* and *P. braunii* are known to grow in our country, there is an extremely small chance for the production of a hybrid in this combination. *P. setiferum* and *P. braunii* in our country live in quite a different localities, therefore their natural hybrid cannot be expected.

P. lonchitis usually grows in alpine or subalpine zones of Europe, while *P. setiferum* is characteristic to the colline-montane zones of the mediterranean and submediterranean regions. There are very few localities where the two species actually meet. Here, at least potentially, they can form a diploid hybrid: *P.* × *lonchitiforme*. The first specimen of this

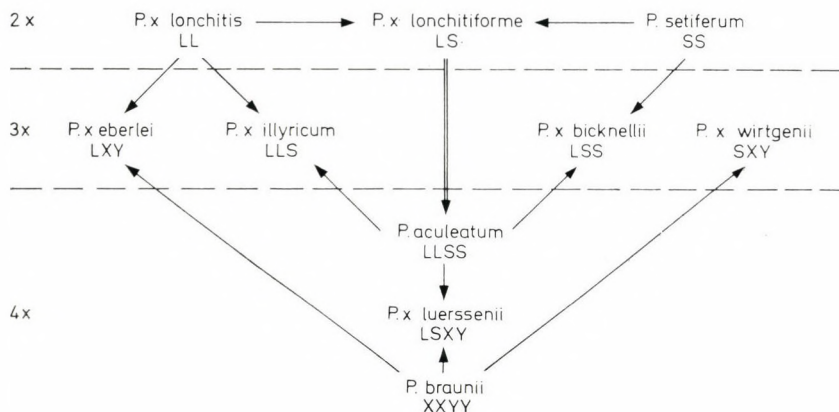



Fig. 1. Cytogenetic relationships in the *Polystichum* complex in Europe

hybrid was collected by ZAHN in 1898 on the Mount Taygetos (Greece), and subsequently described by HALÁCSY (1904).

MANTON (1950) in her famous book (Problems of Cytology and Evolution in the *Pteridophyta*) supposed, that "it ought therefore to be possible to resynthesize *P. aculeatum* by crossing *P. angulare* with *P. lonchitis* followed by colchicine treatment" (*P. angulare* = *P. setiferum*). SLEEP (1966) experimentally verified the alloploid origin of *P. aculeatum*. She successfully crossed *P. setiferum* with *P. lonchitis*, and the few progenies of the mostly sterile diploid hybrid (= synthetic *P.×lonchitiforme*) were fertile tetraploids (= presumed synthetic *P. aculeatum*). Curiously enough, the shape of the fronds of these plants were resembling *P.×illyricum*, instead of native *P. aculeatum*. After some years SLEEP, SCANNELL, SYNNOTT, MCCLINTOCK and REICHSTEIN discovered also wild *P.×lonchitiforme* in Eire (SLEEP et al. 1977). The synthetic hybrids and the natural ones were found to be similar both morphologically and cytologically. During the meiotic divisions of the spore mother cells the setiferum- and lonchitis chromosomes form about 15 bivalents and 52 univalents.

Materials and methods

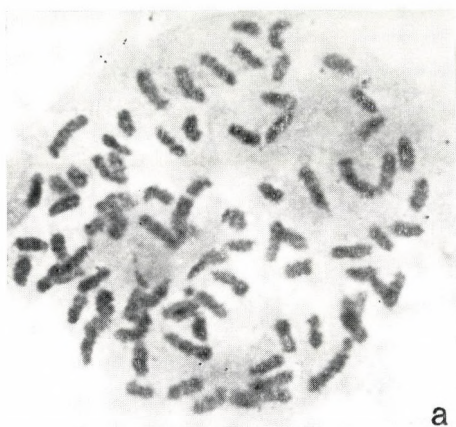
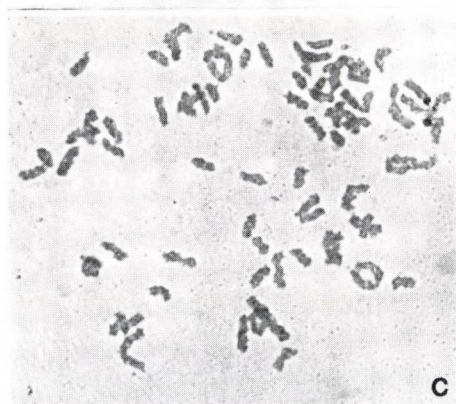
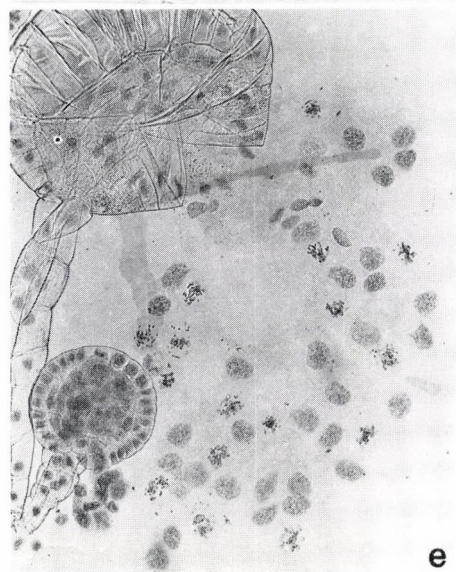
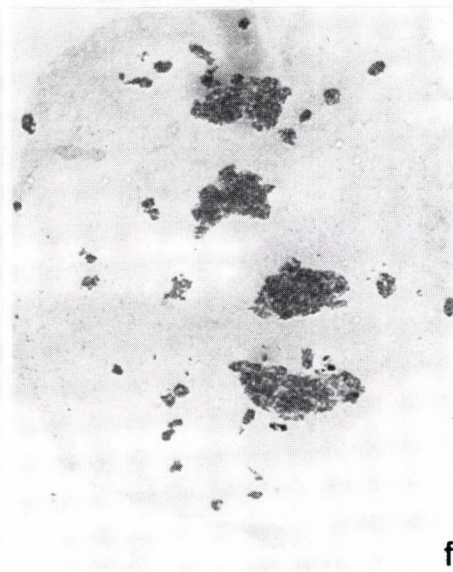
In Hungary between the town Tata and the village Dunaalmás Dr. I. SKOFLEK (ined.) discovered some planted stands of *Pinus nigra* very rich in recently colonized fern species. The genus *Polystichum* was found to be represented mainly by *P. aculeatum* but a few exemplar of *P. setiferum* and *P. lonchitis* were also detected in the forest.

In 1976 one of us (G. V.) collected a hybrid *Polystichum* in this place, tentatively identified as *P.×illyricum*. This plant has been growing ever since in one of the greenhouses of the Botanical Institute of Hungarian Academy of Sciences (Figs 2 and 3). The mitosis and meiosis of this plant was studied here later applying MANTON's squash method (MANTON 1950). Microphotos were taken in fresh preparations on Zeiss NU-1 research microscope.

Results and discussion

The chromosome number in root tips of the hybrid plant mentioned above is 2n = 82 (Fig. 4a, b). The morphology of this plant does not match any of the two diploid species (*P. lonchitis* and *P. setiferum*), but seems to be

Fig. 2. The *P.* × *lonchitiforme*, collected in Hungary

Fig. 3. Silhouett of a frond of *P.* × *lonchitiforme* (× 1/3)

a
b
c
d
e
f

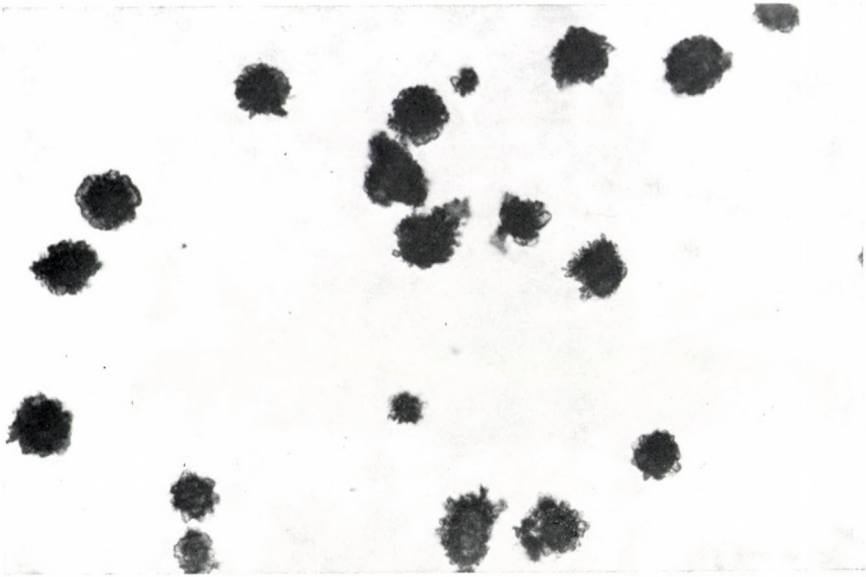



Fig. 5. Aborted spores from the hybrid *P.* × *lonchitiforme* (× 200)

somewhere between them. Since *P.* × *illyricum* should be triploid, the only possible hybrid with diploid chromosome number is *P.* × *lonchitiforme* (*P. lonchitis* × *P. setiferum*).

Studying the meiosis we always found 16 spore mother cells per sporangia (Fig. 4e), and at diakinesis or metaphase I. each cell exhibits roughly 40 univalents and 21 bivalents (Fig. 4c, d). This pairing behaviour agrees with data given by SLEEP (1966) and SLEEP et al. (1977). The failure of regular pairing of chromosomes at meiosis is very conspicuous, indicating a high degree of inhomology between the two genomes of the diploid hybrid. The univalents often produce micronuclei after having finished the meiotic division and/or they are distributed by chance between the poles (Fig. 4f).

As a result of meiosis mostly aborted spores are formed (Fig. 5). Quite exceptionally however, viable ones can be formed, as it has been reported in other interspecific, diploid fern hybrids (LOVIS 1968, 1970, RASBACH et al. 1979). In this case the process of meiosis apparently stops before the second meiotic division and consequently unreduced diploid spores are formed.

←

Fig. 4. Mitosis and meiosis of *P.* × *lonchitiforme*. *a)* Mitosis, 2n = 82 (× 1000). *b)* Explanatory diagram to Fig. 4a. *c)* Meiosis in the same plant, 21 bivalents and 40 univalents (× 1000). *d)* Explanatory diagram to Fig. 4c. (Bivalents in black, univalents in outline.) *e)* 16 spore mother cells in metaphase I. of meiosis (× 150). *f)* Micronuclei in telophase II. of meiosis (× 900)

Conclusions

On the basis of cytological results of mitosis and meiosis we conclude, that in the forest between Tata and Dunaalmás a natural hybrid of *P. lonchitis* and *P. setiferum* has been formed. It is remarkable (although not yet understood why) that the hybrid is more similar to *P.×illyricum* than *P. aculeatum*, a putative allotetraploid hybrid in the same combination. Similar observations were reported earlier by SLEEP (1966) and SLEEP et al. (1977), and actually, HALÁCSY's name also refers to this situation. The hybrid *P.×lonchitiforme* is new for the Hungarian Flora. Further experiments are in progress to raise tetraploid sporophyte progenies of *P.×lonchitiforme* in order to compare it with *P. aculeatum*.

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BOOK REVIEWS

PIMENTEL, R. A.: Morphometrics: The Multivariate Analysis of Biological Data. KENDALL/HUNT Publ. Co., Dubuque, Iowa, USA. pp. 276, 1979.

In the last decade multivariate analysis has become a popular and frequently used research tool in biological sciences. However, a slight gap between interested biologists and mathematicians still exists for newcomers to the field of mathematical biology sometimes feel it is too difficult to learn and use multivariate techniques. They are often faced with many difficulties and problems when results are to be interpreted. Most of the relevant texts on basic principles of multivariate analysis are written for sociologists economists or psychologists and these are usually not satisfactory for a biologist. Other books discuss these methods from a special point of view (e.g. numerical taxonomy) but these works may also be difficult to read if a beginner wants to get an insight into multivariate methodology. Hence, all books are welcome if the author's primary aim is to facilitate the advance of biological and mathematical way of thinking. I have a feeling that this book by R. A. PIMENTEL (California Polytechnic State University) meets this principal requirement.

The main title of the book seems too limited it might suggest that this guide is written for morphometricians and taxonomists, but this is not the case. The author devotes a vast section to the ecological ordination which is never termed morphometrics. Therefore the real subject is covered by the subtitle.

There are ten chapters in the introductory chapter (7 pages) the author gives a simple illustration of morphometric analysis and outlines the main purpose of the book. The second chapter (23 pages) includes elementary matrix algebra and some basic principles of multivariate statistics. This chapter is well-illustrated, mathematical derivations are given in full details to facilitate verification. It is to be noted, that derivations are sometimes too circumstantial, e.g. on the top of page 25, whose result directly follows from the expression on the bottom of the previous page. In Chapter 3 (13 pages) multiple regression and correlation are described, for the sake of completeness. The purpose of this chapter is to convince the reader of the shortcomings of these methods. Chapter 4 (33 pages) seems to be the most valuable part of the book. Principal component analysis is described in a clear, straightforward manner. PCA is illustrated by simple example, limitations of the method and mathematical considerations regarding the interpretation of results are presented. However, a reader familiar with PCA will surely disagree with the interpretation of the illustrative example (p. 63). The explanation of two components, each accounting for less than 1% of the total variance, seems to me useless and misleading.

Principal component analysis is extended to the multigroup case in Chapter 5 (11 pages). This procedure is rarely used in practice, therefore the purpose of the author to draw our attention to this method can be particularly approved. Chapter 6 (9 pages) seems very short regarding the popularity of the method discussed here. The reason is obvious, the literature on factor analysis is full of contradiction, misunderstandings and inconsistent terminologies. Furthermore, the method itself may be strongly criticized. It is the merit of the author that he finds the most appropriate way of discussion and clearly shows the most important approaches to factor analysis. In Chapter 7 (30 pages) canonical correlation analysis is introduced. The illustrative example comes from botany, the set of morphological features of a laminarian species is correlated with environmental variables. A principal component approach to canonical analysis is also presented.

Chapter 8 (41 pages) will probably receive the greatest attention from biologists. Ordination and cluster analysis techniques are widely used in all fields of this discipline, but here the emphasis is laid on ecological applications. This chapter is a comprehensive review

of ecological ordination; resemblance functions, methods of data transformation and the different methodologies are discussed in some details. Algorithms of the procedures are also given, but sometimes incompletely, as in the case of principal co-ordinate analysis. Cluster analysis is dealt with in brief, the author devoted only 9 pages to this topic.

The next chapter (12 pages) introduces multivariate analysis of variance and covariance. Discriminant analysis is treated in detail in Chapter 10 (44 pages), the largest chapter of the book. The author clarifies many terms of DA, presents several models for two-group and multigroup discriminant analysis.

In addition, the output and input specifications of two computer programs for morphometrics are presented. It is unfortunate that the reader is not informed about the availability of these programs. The book is supplemented by a very useful glossary of the most common terms in multivariate analysis. The bibliography is short, the number of references in the book has been kept to a minimum.

The book is very attractive in layout and of a high standard. However, there appear to be relatively many misprints and errors. Better editing could have removed more of the typographical errors. Although a considerable errata has been enclosed, several errors remain in the text after correction. However some mistakes attributable to the author can be detected. Some of them will be mentioned here. The JACOBI canonical form is not simply a product of an eigenvalue and an identity matrix as implied in page 29. The formulae for percentage contributions are frequently incorrect. The percentage of the variance of an individual accounted for by each component (bottom of page 72) should read

$$100 \sum_j (a_{ij}x_{jk})^2/s_{xk}$$

where, in fact, s_{xk} is not variance but the sum of squared deviations from the centroid. The summations according to j should be deleted from both formulae on page 111. The variance of a standardized variable is not p but 1 (bottom of page 67). The product of eigenvalues should be equal to the determinant of matrix **A** (page 243, fifth line up from bottom). The book by B. EVERITT was published by HEINEMANN, London (page 265).

As a whole, R. A. PIMENTEL has produced a book that provides a concise guide to multivariate analysis for biologists, satisfying a strong need. The presentation is intelligible, the book is easy to understand in spite of the few drawbacks mentioned. I think it is an extremely useful text for a wide range of readers, not only for biologists. It is a valuable book for anyone who wants to use multivariate techniques in his own research field.

J. PODANI

CASPER, S. J.–KRAUSCH, H.-D.: Pteridophyta und Anthophyta. 1. Teil: Lycopodiaceae bis Orchideaceae. VEB Gustav FISCHER Verlag, Jena. 1980. 403 pp, 1038 figures.

This book is the 23rd volume in the series "Süsswasserflora von Mitteleuropa" (hrsg. ETTL, H.–GERLOFF, J.–HEYNING, H.).

The volumes of the series are at the same time the second edition of "Süsswasserflora Deutschlands, Österreichs und der Schweiz" published by PASCHER, A.

Hydrobiological research oriented to environmental protection has necessitated the new edition of the series for determining the plants of fresh waters. As confirmed cenological and ecological research works of the past 30 years, water macrophytes are efficient tools for ecologists, cenologists, and hydrobiologists in practice, having a firm taxonomical basis. Aquatic plants are good indicators of water quality.

The book is divided into a general and a specific part. In the general part, a systematic and taxonomic survey is given as well as an enumeration of those families to which the individual aquatic plants belong. The expressions i.e. aquatic plants, fresh-water macrophytes and the terms helophyton, pleustohelophyton, pseudohydrophyton are given in explanations. All the fundamental floristical works can be found in which data referring to aquatic plants occur. The chapter on ecology contains an explanation of various ecological technical terms, while the part on cenology contains the aquatic vegetation units. In the chapter on chorology, the classification of the floral elements, is provided. The general part ends with two taxonomic key series, based on generative criteria or on easily recognizable characteristics. A separate taxonomic key has been elaborated for the submerged aquatic plants.

In the special part, the taxonomic keys of some 280 aquatic, water-shore, and mud-plants either native, to Europe, or introduced or colonized are given as well as a detailed

morphological description together with the chromosome number can be found. The ecological characteristics, habitat, life form, distribution and the authors of the maps on the species distribution are presented too. With respect to certain species, data on for example the reproduction characteristics, and economic utilizability, can also be found.

The description and determination of the plant species, are enhanced and completed with ample illustration.

A disadvantage is that no species register has been given, and so it is difficult to find the individual species and the relevant descriptions in it.

The series, or its volume in this new publication furnishes a comprehensive picture of aquatic macrophytes, and — as a consequence of its abundance in data — it is a useful handbook for taxonomists, ecologists, and specialists in hydrology, dealing with these plants.

M. Kovács

H. P. Blume, R. Bornkamm, Th. Kempf, R. Lacatasu, S. Muljadi and F. Raghi-Atri: Chemisch-ökologische Untersuchungen über die Eutrophierung Berliner Gewässer unter besonderer Berücksichtigung der Phosphate und Borate. Schriftenreihe des Vereins für Wasser-, Boden- und Luft-hygiene 48. Gustav Fischer Verlag, Stuttgart, 1979, pp. 152.

Still fresh water has multiple uses considering the protection of the landscape, or supplying drinking water, or water sports. Their role in this respect is especially important in densely populated industrialized areas where there is an increased demand for holiday resorts.

Therefore, the preservation of the chemical-ecological characteristics of the still waters in Berlin including the protection of the vegetation belt on the shores is an important task. The authors examined the borate, phosphorus and nitrogen content of four different still waters in Berlin (Tegelsee, Oberhavelsee, Heiligensee and Pechsee), and also some other parameters that can be correlated with the above chemical components. The choice of these four lakes was due to the fact that these four lakes come under the effect of human activity differently. The field researches covered water profile, deposits, pore water and reed (*Phragmites australis*) as the most important shore-plant, as well as some plankton tests. These studies were completed with laboratory experiments, in the course of which the effect of fresh mud on pH, redox potential and ion-concentration as well as, its borate and phosphorus adsorption and mobilization were studied. Reed was also examined in the course of planting experiments to determine the effect of borate, phosphorus and nitrogen on the growth and composition of reed plants under controlled conditions.

The most important results described and summarized in the article are as follows: Tegelsee and especially the waters supplying it contain a very high quantity ot nitrogen, phosphorus, and borate. The accumulation of these nutrients during the past decades has led to eutrophication, and together with this, to the increased destruction of the water quality. The withdrawal of the reeds in the waters of Berlin is — indirectly at least — in connexion with eutrophication because this — as has been proved also by experiments — decreases the mechanical strength of reedstalks. The material balance calculations indicate that about 5 tons of dissolved phosphorus remain in the lake yearly, that is, even on the basis of senate committee's opinion, we must reckon with a double phosphorus concentration in the lake during a period of ten years. About three quarters of the phosphorus content is bound in the deposit of the lake. In comparison with this, the accumulation of borate is much smaller but it is ever increasing as well. This danger is aggravated by borate being more mobile since it is bound not so firmly as phosphorus, and under the effect of even a small reduction in the quantity of the pH it changes back into its dissolved form the loading of the lakes is strongly influenced by the performance of the northern canal leading to the drainage works of Ruhleben, as well as by the precipitation quantity changing year by year. Concentration in the direction of Havel is constantly decreasing which partially dissolves the water in the lake.

The bond forms of phosphorus change according to the type of the deposit. In Heiligensee calcium phosphate dominates, and it occurs also in a great amounts in the sapropel, rich in lime of the Tegelsee. In the purely acid water of the Pechsee, on the other hand, phosphoric acid is mainly bound to iron and aluminium. The experiments carried out by shaking the fresh mud indicate that in these contaminated waters, balance and the self-purifying ability is mainly put into effect by the dissolved oxygen content, besides a changing phosphorus content, pH and redox potential.

Biocenoses influence the phosphorus, borate and nitrogen metabolism only to a small extent. The results of field examinations and of cultivating experiments show that reed

concentrates a rather high quantity of these three elements but since the shore vegetation is almost missing, these quantities change the extent of the total metabolism only insignificantly. This is expecially so in the case of borate, since the B : N and B : P ratios in the plants are much smaller here than in open waters. Besides, we can also reckon with the phenomenon that materials bound in the shore vegetation will get back into the lake or into its almost deposit quantitatively. Similarly, the quantity of material bound in the plankton will also not cause a considerable change in the borate, nitrogen of phosphorus metabolism of the lakes; they can at the most cause small fluctuations in the main growth periods of the plankton organisms only. Therefore, the water purifying experiments could not be started on the biocenosis.

The ability to carry on self-purification in relation to phosphates is of a rather high degree, which is due to their bond in the deposit, in both the less loaded waters and the hypertrophical waters of Berlin, in the case of usual 6–8 pH values; this is however influenced by the redox potential to an specially great extent. It also follows from this that in the stagnation phases phosphorus can be easily mobilized, above all in the deep (max. depth 16 m) Tegelsee. The program of pulling down decided not long ago by the city leaders — planning among others also a phosphorus prevention apparatus — will therefore make its effect be felt only after a long time has passed. The high degree of phosphorus concentration can successfully be prevented only if the mud of the lake is covered with clay.

For the time being it cannot be stated whether the growing borate concentration has a harmful effect on the water ecological system. In spite of all these, the authors' experiments carried out with reed indicated that a borate may get concentrated to such a degree in the Tegelsee that it has a harmful effect on reed, and even — according to the literature — on other groups of the zooplankton as well. Therefore, the authors consider it reasonable that the borate content of the waters of Berlin should be reduced, by introducing for example the method of water purification by lime + iron chloride in the course of which the moval of heavy metal contents is also carried out, in addition to reducing the borate and phosphorus content.

The paper is supplemented with 117 bibliographical references, 43 tables, 26 figures and an appendix of 26 pages (with graphs demonstrating chemical investigations).

Zs. T. Dvihally

Ed. K. C. Smith: Photochemical and Photobiological Reviews Vol. 4. Plenum Press New York 1979.

The book is divided into 5 chapters and comprises 333 pages. The various chapters are written by authors well-known in the international literature on the subject. The reference lists at the end of the individual chapters contain the bibliographical data of specialised articles up to and including 1978. The contents of the chapters can be summarized as follows:

1. W. W. Ward: Energy Transfer Processes in Bioluminescence. Bioluminescence essentials consists in transforming chemical energy into light energy with light effectiveness in biological systems. A signal of light effectiveness is that temperature carries away energy only to a small extent and so-called cold light comes into existence. The transformatory process is enzymatic and in organisms possessing enzymatic systems the phenomenon has an adaptive function. The chapter presents a short summary of the reaction mechanism and describes the presumed ways of energy transfer from the viewpoints of organellaric structure and biochemistry. The forms of bioluminescence in various taxonomical categories (in bacteria in tunicata and ascidia, fungi etc.) are discussed at length and in detail.

2. L. H. Pratf: Phytochrome: Function and Properties. The properties and characteristic effects of the two forms of the phytochrome are summarized on the basis of nearly 300 articles quoted. The effect of active phytochrome can be testified in the organization of membraneous structures, and in the regulation of gene expression. With respect to the isolation and in vitro measurement of its phytochemical reactions suitable methods have been known and described in specialized articles. On the basis of immune-chemical identification methods it has been pointed out that the active phytochrome generally occurs in young, rapidly growing plant cells, and considering its subcellular localization it links with the membrane, around the cytoplasm and with the membranes of the cell organelles. Considering its molecular characteristics, it is categorized as a chromo-protein, its protein carrier molecular weight is known. The chapter also contains suggestions for consideration with respect to the tasks of future research in the clarification of the functional part played by the phytochrome.

3. Govindjee, P. A. Jursinic: Photosynthesis and Fast changes in Light Emission by Green Plants. After a general summary of the processes belonging in PSI and PSII the photosynthetical light reactions, the linkage of their components to membranes is described in brief. One of the most important events in light reaction is fluorescence. The authors describe in detail the factors influencing the fluorescence output of chlorophyll-a, its life period, and its quantitative output, and a methodological summary of the possibilities for measuring the characteristics of fluorescence is also given.

The fluorescence characteristics related to the charged state of antenna chlorophyll-a molecules are compared with the so-called delayed light emission (LE) characteristics. There exists a direct relationship between the latter and the state of chlorophyll-a molecules lying in the reaction centres. Methods for measuring this relationship are also suggested as well as a summary of the factors influencing the life period and the Kinetics of DLE.

4. Ninnemann: Photoreceptors for Circadian Rhythms. In the functions of all the living organisms, from the one-cellular algae to man, such a determined endogenous rhythm can be observed, that lasts for about a 24-hour-period (the designation also originates from this: circa + dies = about + day). Several examples can be found in the chapter on the forms and duration of daily rhythms (22–30 hours in plants, and 23–26 hours in the animal kingdom).

In daily rhythms, light has an outstanding role. On the nature of photoreceptors suitable for the absorption of light, and on the effect of the spectral composition of light (blue, green and red light) in relation to different plant and animal species, several examples have been given in this chapter. Photoreceptors cannot be associated with a definite organ but their localization can be related to membranes. The knowledge of daily rhythms has an outstanding role for physiologists.

5. R. O. Rahn: Nondimer Damage in Deoxyribonucleic Acid Caused by Ultraviolet Radiation. Under the effect of ultraviolet radiation, DNA breaks down while so-called pyrimidin dimers are being formed. This statement is supported by a number of experimental data. However, during the breakdown induced by photo-processes, non-dimer damage can also be caused, under normal conditions the cell can repair the damage as it possesses a specific repair system for that purpose.

The chapter presents in detail, actual evidence and measuring methods of non-dimer breakdown. This kind of UV radiation effect has been summarized on the basis of examinations carried out from biological and biochemical viewpoints in bacteria and phagocytes. Interesting data can be found on the relationship between UV-induced breakdown and the effect of endonuclease.

The prospects of developing a specific method employable in DNA fragment analyses, based on the phenomenon, are favourable.

A. H. Nagy

Goodman, L. A. and Kruskal, W. H.: Measures of Association for Cross Classification. pp. 146. Springer-Verlag, New York–Heidelberg–Berlin, 1979.

In this book all the important literature on this topic may be read in the original, for the authors have collected their works on the subject published between 1954 and 1972, in one volume. All of them were printed in J. of the American Statistical Association, thus a uniform layout is also provided. Let us now survey the main stages of the research carried out over almost two-decades according to the titles of the individual publications:

I. Emergence of the problem and the new measures (1954)
II. A further discussion and references (1959)
III. Theory of approximating samplings (1963)
IV. Simplification of asymptotic variances (1972)

In the introduction the authors emphasize that they use the term twofold cross classification only for the sake of simplicity and many of their results can be extended to multiple cross classifications as well. Concerning the classification, the population is supposed to be fully known; for example, if a TV-manufacturing company wants to advertize its sets in a newspaper, then the most important information for that company can be what newspaper is read by most of those who already know the institution of TV (let us not forget that we are in 1954 at this stage). This time the reasonable measure of classification can be the quotient which expresses the ratio of readers of the newspaper at issue to those possessing a TV set. The authors emphasize that the measures introduced by them are not universal either, and

their usefulness always depends on the circumstances. At any rate, we can expect of a measure which is to be introduced that

(i) it registers values between −1 and +1; −1 and +1 for the case of "full connexions", and zero for the case of independence, or

(ii) it falls to the value between 0 and +1, that is +1 expresses the "full connexion", and zero the independence.

A grest majority of the traditional measures is usually built on the independence test based on x^2 statistics. If we work with the traditional measures in a comparison between two cross classifications we are already come up with difficulties. Let us suppose, for example, that the values of contingence coefficient

$$C = \frac{x^2/v}{1 + x^2/v}$$

are 0.56 and 0.24, in two different cross classifications. In this case one would like to express that — the connexion is closer in the first classification, but the authors seriously warn everybody from drawing this conclusion.

Then several measures are introduced which adjust to the individual problems and are easily interpretable. The problems are classified according to three viewpoints, namely

— background, continuity
— establishment of ranks,
— symmetry.

In the second chapter of the book, the authors have tried to compare their measures with other measures. It is here that the work of one of the Hungarian mathematicians of the 19th century, József Kőrösi, is mentioned. In his work cited as "Kritik der Vaccinations-Statistik und neue Beiträge zur Frage des Impfschutzes" (1887), he defined such measures one of which was identical with one of the measures described by Yule 13 years later for 2×2fold cross-classifications.

In their third publication — that is, in the third chapter of the book — the authors describe how the normal distribution of populations can be used for testing the significance of the differences between the measures introduced and the relevant populations. For no sampling problems have arisen so far because measures of the association the sizes of the populations were supposed to be known. This chapter virtually deals with the theory of approximation in samplings.

With the fourth and at the same time last part of the book, the work becomes complete by presenting a simplification possible in calculating the asymptotic variances, if the introduced values of connexions occur as quotients. An understanding of the complicated mathematical relationships is enhanced by the symbols introduced earlier, being used consistently throughout the whole volume.

The terminology used in the book is concise and easily understandable and as, appears also from this review, the examples taken from practice also touch upon anthropological, sociological applications beyond the biological and ecological ones. The book can be recommended not only to mathematicians working in the field of biological applications, but — considering the frequency and importance of cross classifications — to biologists of a theoretical outlook as well.

A. Eőry

Halldin, S. (ed.): Comparison of forest water and energy exchange models. Proceedings from an IUFRO workshop, Uppsala (Sweden), September 24–30, 1978, International Society for Ecological Modelling, Copenhagen, 258 pp, 1979.

This book has compiled the results from an IUFRO (International Union of Forestry Research Organizations) workshop arranged in Uppsala, Sweden in the autumn of 1978 to compare different micrometeorological and hydrological forest models using the same input data. The data were collected in the main research site of the Swedish Coniferous Forest (SWECON) Project in Jädraas.

Following the editor's preface and foreword of the chairman of the workshop the book is divided into four sections including 19 papers altogether.

In Section I the data collection and the computer facilities are described. The first paper (by Lindgren and Perttu) contains the climatic characteristics of the main research

area and 6 measurement sites where the different climatic elements (temperature, humidity, wind speed, various radiation components) were measured and deals with the construction of three data bases with time resolutions) of one day, one hour and 10 minutes respectively. In the second paper LINDROTH and NORÉN give a brief description of evapotranspiration measurements carried out in a sparse, 120-yeard-old Scots pine forest, the transducers used for the micrometeorological measurements, the automatic data collection system and data processing. The third paper (by SVENSSON) summarizes the facilities of the data base system (ECODATA) developed for storage, correction and retrieval of continuously recorded eco-system data. The mean features of programs used for insertion, correction, storage and retrieval are given too. The last paper of this section (by LOHAMMAR) deals with the important characteristics of the simulation package (SIMP) which is an interactive mini-computer package and performs simulation of models having the form of first order ordinary differential or difference equations. It makes comparisons of simulated and measured data possible.

During the workshop and alterwords nine models from different countries were used for the comparisons. The models could be divided into two categories, namely with diurnal and with seasonal resolution respectively.

In Section II the models with diurnal resolution treating radiation interception and sensible and latent heat exchange are described. There is a detailed description of structure, the required input variables of the models is as follows: the microweather simulation model developed to explain the microweather as a function of the properties of the plant and soil and of the weather conditions at some height above the coniferous forest (by GOUDRIAAN); CANOPY model describing energy exchange in the pine forest and worked out to complement the measurements of evapotranspiration at Jädraas (by HALLDIN, GRIP and PERTTU); model (SHORTWAVE) for the quantitative and qualitative description of shortwave radiation within and above vegetated canopies (by LEMEUR and ROSENBERG); physical model to simulate energy exchange of plant canopies (by PERRIER). Modifications of the models for adaptation to the conifeıous forest and simulated results are discussed too.

Section III summarizes the main features of the models with seasonal resolution concentrating mostly around soil water, precipitation interception and evapotranspiration processes. They are constructed for simulation of water state and flow in the soilplant — atmosphere system (by HANSEN); to describe the functional relationships between evapotranspiration, atmospheric conditions and water content in the root zone (by ITEM) and the abiotic processes governing heat and water flow in a layered forest soil (by JANSSON and HALLDIN) and to calculate actual evapotranspiration from potential evapotranspiration with leaf area, root development and soil water as limiting factors (by JANSEN) and the transpiration and interception components of evaporation from forests and the throughfall and stemflow (by GASH, LLOYD and STEWART).

The fourth section of the book presents the results of the workshop and the work following it. It includes five papers dealing with comparisons of different models on the bases of common data. Models are compared with respect to predictions of short and longwave radiation and net radiation (by LEMEUR, GIETL and HAGER) and energy exchange (by PERRIER, HALLDIN and GARTHE), to calculate the interception of rain water (by ERIKSSON and GRIP) and actual evapotranspiration and its components transpiration and evaporation (by KELLER). A discrepancy was found when comparisons were made between energy and water balance model of evapotranspiration (by GRIP, HALLDIN, JANSSON, LINDROTH, NORÉN and PERTTU). The reasons for it and some probable errors in measurements and calculations are discussed in detail. In the last paper of the section UTAAKER sums up the conclusions of the workshop and emphasizes the importance of the energy and mass exchange models in descriptions of the soil — vegetation — atmosphere interactions.

The book is a considerably contribution to the ecological modelling and contains detailed results for the specialists in micrometeorology, hydrology, soil science, plant physiology, systems analysis and ecological modelling.

I. MÉSZÁROS

M. FRIEDMAN (ed.): Nutritional Improvement of Food and Feed Proteins. Advances in Experimental Medicine and Biology, vol. 105. Plenum Press, New York and London. 1978.

This bulky volume comprises 40 excellent studies by outstanding international researchers of 10 countries. Almost all fields of food sciences, are dealt with thus it is impossible to prepare a suitable summarizing review. We have not even grouped the studies because we hold the view that the very merit of this volume is its multifariousness. Specialists dealing

with any field of food sciences will find this volume most worthwhile but plant breeders, plant biochemists and physiologists, as well as even protein analysts will find important pieces of information in it. Instead of a summarizing review of the studies, we shall very briefly make a statement on each of the studies.

1. The experimental determination of the daily protein requirement of children 7–10 year age-groups, on the basis of nitrogen balance, shows that this requirement can be put at 34–44 gr protein (Abernathy and Ritchey).

2. Fortesan is a fortified food designed for infants and children, containing wheat flour, defatted soy flour, soy oil, powdered milk, powdered cocoa, vitamin and minerals. In the study, the fate of Fortesan is followed from the laboratory experiments through industrial production, up to its large scale use (Monckeberg and Chichester).

3. The quality of corn flour, containing lysin and tryptophan only in small quantities, can be improved by adding whole soybean to it. It is not only the quality of protein that improves but — owing to the high oil content of soybean — the calory value of the corn flour will be higher too. A quantity of 15% soybean in the mixture does not alter the rheological and organoleptical characteristics of the tortilla prepared from it (Bressani and co-workers).

4. The examination of the chemical composition of food protein, or its amino acid analysis, can characterize the quality of protein accurately, this value however must be verified in biological experiments, by a simultaneous measurement of several kinds of parameters (Devadas).

5. The relative amount and proportion of essential amino acids can be changed without changing nitrogen retention until at least one amino acid becomes limiting (Clark and co-workers).

6. A bioasssay the protein quality in wheat varieties of was carried out and a comparison was made between the results of human bioassays and those of bioassays on small laboratory animals in the framework of feeding experiments (Kieas and co-workers).

7. Urea as non-protein nitrogen source is used in practice for feeding ruminant animals. It can be used also in human nutrition experiments, for the time being however only in scientific and clinical laboratories (Kies and Fox).

8. The consequences of excess amino acid intake; the response by organism and central nervous system to amino acid supply were elaborated (Munro).

9. The quantitative determination of the cystine content of the hair shows that there can be a potential relationship between protein malnutrition and the reduced cystine content of the hair (Friedman and Orraca-Tetteh).

10. Problems of the evaluation of bioassays elaborated for the investigation of protein qualities (McLaughlan).

11. A study dealing with dietary plant fibres in foods, and summarizing the problems of terminology, as well as presenting an analysis and characterization of fibres (Spiller and Gates).

12. Increasing the production of protein in plants by the external regulation of the biochemical mechanism of photosynthetic carbon assimilation. The leaf protein production in alfalfa can be increased by making use of the circumstance that the plant photosynthetizes in an environment containing carbon dioxide at a raised concentration (Platt and Bassham).

13. The nutritional quality of cereals and leguminous plants can be improved by nutritional or toxic factors (Bozzini and Silano).

14. The methods aimed at improving cereal protein qualities are discussed in the study. In the older methods the supplementation of nutrients and fodders obtained from cereals with essential amino acids or with protein concentrates was used. Recently, it is rather high lysine mutants that are applied (Mertz).

15. The quality of the proteins of corn can be improved by breeding. Further possibilities and economic considerations of this are analyzed in the study (Deutscher).

16. The grain yield of wheat variety developed in Nebraska ("Langota") is of a high protein content, grinds well and retains its good qualities even under different environmental conditions (Johnson and Mattern).

17. Chemical analyses and biological experiments on rat, poultry and pig clearly show that high lysine cultivars of barley are of much better qualities than those containing a low level of lysine quantity. However, the grain weight and the grain yield of most of the lysine genotypes are low (Eggum).

18. The improvement of the quality of cottonseed by means of genetical and agronomical methods and its use as a nutrient resource (Cherry and co-workers).

19. Mixed protein fodder given to chicken and rats often produce better growth than foods given separately; this is not always related to a balanced amino acid composition and the presence of essential amino acids (Woodham).

20. The supplementation of protein foods with free amino acids requires great caution since the growth response is not linear and animals are even able to adapt to a diet of lower protein content (Benevenga and Cieslak).

21. The flour of dry-roasted navy bean (*Phaseolus vulgaris*) and its mixture with cereal protein are analyzed from nutritional viewpoints (Yadav and Liener).

22. The examination of oilseeds and legumes with respect to their nutritional quality — after mixing them with cereals — show that they can be favourably used for feeding purposes (Sarwar and co-workers).

23. Isolated soybean protein products from which the growth-retarding substances have been removed or destroyed by heating are suitable for feeding calves with. The experimental design for this is described in the study (Pelaez and co-workers).

24. The determination of the nutritional quality of *Vicia faba* var. *minor*, *Brassica napus* and *Brassica campestris* by feeding swines with them (Aherne and Lewis).

25. The microorganisms living in the rumen of ruminants can build inorganic nitrogen compounds into amino acids and proteins which are transformed by the ruminants into animal proteins. Knowledge of this biochemical mechanism can be important for animal protein production (Chalupa).

26. The question of availability and usability of supplementary amino acids added to foods and fodders can be decided only on the basis of long-term experiments on growth rates, nitrogen balance and of data obtained by the analysis of tissues (Ostrovski).

27. The examinations involved 27 kinds of -N- and -N-substituted lysine derivatives with respect to their suitability for use as lysine sources in nutrients (Finot and co-workers).

28. To improve the quality of plant proteins they are supplemented with various basic amino acids. However, methionine and threonine supplemented to the protein transforms unfavourably in the course of heating (baking, cooking), therefore, the acetylated derivatives of these amino acids were added to plant proteins and then the bioavailability of the latter was examined (Boggs).

29. The nutritional quality of proteins can be improved also by attaching amino acid, which is lacking in the plant, covalently to the protein. This covalently linked amino acid seems to be available in the experiments on feeding (Puigserver).

30. The alkaline treatment of food proteins is frequent in technological processes. This treatment however destroys a considerable quantity of threonine, cystine, lysine, tyrosine and arginine residues. By the acylation of protein this destruction can be prevented or reduced to a minimum level (Friedman).

31. By means of the mutant of Corynebacterium glutamicum — with the exception of L-methionine — all the essential amino acids can be produced by direct fermentation, with the use of cheap carbon sources (Nakayama and co-workers).

32. By means of plastein reaction, amino acids can be incorporated into food proteins and by this a possibility arises for favourably changing the amino acid composition of the protein (Arai and co-workers).

33. Germination enhances the nutritional quality of wheat and soybean. Germinated soybean incorporated into bread improves the quality of the latter (Finney).

34. A thorough-going critical survey of the problems related to improving the quality of bread protein is presented in this study (Betschart).

35. Whey obtained as a by-product in cheese manufacture can be used for increasing the protein content of soft drinks, or for preparing drink of new kind (Holsinger).

36. A survey of the possibilities of a utilization in food industry of soybean proteins on a very large scale is presented in this study (Bookwalter).

37. The reserved proteins of cottonseed can be given as supplements to various foods. Such cotton varieties could be produced and such industrial process could be developed the seed-power of which is of white colour and of low gossypol content (Cherry and co-workers).

38. Yeast proteins should also be considered as a supplementary food source. During the extraction, the proteins may decompose by proteolysis and may become contaminated with nucleic acids; this can be prevented by the chemical derivation of proteins (Kinsella and Shetty).

39. Inexpensive automated amino acid analyzers can be assembled by means of commercially available components (Beecher).

40. A glossary of nutritional terms and a list of abbreviations close the volume to which an ample bibliography is attached (Friedman).

S. Szilágyi

WARD, D. V.: Biological Environmental Impact Studies Theory and Methods. Acad. Press, New York, pp. 157, 1978,

The aim of this book was to survey the theory and method of analyzing the environmental impacts which have created so many problems thereby providing assistance to researchers working in this field.

Since this will presumably be the predominant frend in the future ecology too, a summary of this kind, giving an intensive survey of theoretical and methodological problems arising in the source of research, is especially valuable.

The book consists of seven large chapters. In the first environmental impacts are analyzed together with a definition of environmental impact itself, followed by an evaluation various entire impact studies. With respect to impacts, the author calls attention to the role played by an ecological outlook. Examples of actual cases that of DDT are given to illustrate the damage that can be caused if persons without a right attitude and lacking the knowledge required carry out an assessment of the effects. The importance of taking the joint effect of several factors into consideration is stressed as is the measuring of the changes in processes only at the ecosystem level when the environmental impacts are assessed, since the extent of a change can only be given in this way.

The second chapter deals with site studies, their aims, and the description of structural, functional and temporal changes. The need and importance of site studies is emphasized. Since we wish to present the results of environmental impacts on a single system, we have to fully understand the system itself which is only possible by means of a very accurate site study. With respect to structural examinations, the author suggests that the species composition, abundance, nutrient chains, ecological dominance, indicator species, and species diversity should be stated. In the course of functional description, the determination of productivity is considered to be most decisive at the different trophication levels. In describing energy flow diagrams should also be drawn, indicating all the possible paths. If we take only one random flow path it will give a false picture of the system. Nutrients, decomposition processes, and the temporal changes in structural and functional characteristics are touched upon.

Chapter Three is concerned with the modelling of the system. After showing the obstacles and limitations of modelling, an outline of its historical development is given, and the making of a "step-by-step" model is demonstrated by a concrete example. Attention is also called to the possibilities of making errors. The individual steps of making a model are described very illustratively, from the phase of making a diagram up to the computer programming. For an easier understanding block diagrams, figures and ready made programs written in FORTRAN language are provided.

Chapter Four treats site experiments. The necessity and the hindrances of site experiments are surveyed, but it is also stated that an experimental approach of this kind can provide such data which probably would not come to light in a site research. Observation of response reactions given to intentional action promotes a better understanding of the function of complex systems. The limitations of taking samples are discussed mere also and the problems of principle and practice in this respect are analyzed in detail.

A comparison is made between site and laboratory studies in Chapter Five. The danger of extrapolating results obtained in an artificial environment, is pointed out as well as the fact that the factors producing laboratory changes can take a quite difference course of action under natural conditions. In spite of this, such physical model systems have a very important role in partial research. Their usefulness is a function of the complexity of the model.

Chapter Six gives actual examples of how we should carry out a biological environmental impact study. The effect of insecticides, and the role of canalizing and depositing in marsh lands are also discussed.

Chapter Seven provides a short summary and reviews the obstacles and difficulties in carrying out impact studies.

The book is extremely well set up, and of fine lay-out. At the end of each chapter, a detailed list of references is given. There is an index, curate, and the great number of figures and tables is most useful.

University students, will benefit from this book in addition to the researchers working on the topic.

Csilla Cs. BÉRES

Növényrendszertan (Plant taxonomy). Ed. T. HORTOBÁGYI. Tankönyvkiadó (Publishing House of Textbooks), Budapest, 1979.

The aim of this book is to meet the demand arising of both university teaching and teachers training colleges in this branch of science. It should be a highly desired textbook since the preceding plant taxonomical handbooks and textbooks — in spite of their being published in several new editions — were sold out a long time ago and from the viewpoint of a systematical material of knowledge they were already in need of the newer research results and therefore became obsolete. To make up for all these shortcomings dr. Lajos FERENCZY, university reader Dr. Tibor HORTOBÁGYI, university professor, dr. Tamás PÓCS former college teacher, and Dr. Tibor SIMON university professor in cooperation, wrote a clearly defined and extremely well-edited textbook for teachers in botany and for the students on the material included in the textbook.

With respect to the set up the methods of the taxonomists of evolutionary history, above all the system of Rezső Soó served as a basis. From the viewpoint of developing the system, along with the new morphological and biosystematical principles, data of biochemical and phytochemical materials that prove kinship connexions have also received increased emphasis. In the new taxonomic division consisting of 14 genera, the application of serological methods was also elaborated on. So, for example, in the field of Hungarian phytosystematical education it is still unusual that *Paeoniaceae* is placed from the sphere of *Ranunculales* into the order of *Dilleniales* or that *Salicales* precedes *Cucurbitales*. However, an easier understanding of the textbook just as in the case of previous works of similar topics, enhanced by the abundant illustrations. The proportion of the share given to the individual genera in the text book of 753 pages, with respect to certain subunits of Angiospermae, is debatable.

In the course of studying the book smaller mistakes and shortcomings can also be found, however, these do not influence the importance of the highly desirable book, and they can be eliminated in the subsequent new editions.

GY. BODROGKÖZY

Scott, T. K. (ed.): Plant regulation and world agriculture. Plenum Press, New York and London. 1979.

One of the great problems of mankind is the production of food in the necessary quantity, even today. If we do not succeed in producing the satisfactory quantity and quality of food needed by man, then a crisis never experienced by mankind will arise. The basis of food production is the plant produce. The number of experiments is relatively small that put for themselves as an aim to coordinate the possibilities of applying materials and methods in plant regulation with a view of increasing the yield of nutrition plants (in a wide sense of the word). Effectiveness can be increased only by co-operation between basic and applied sciences. In the present volume only such lectures can be found that deal with the realization of the target mentioned above.

The greatest part of the volume is occupied by the presentation of applied techniques related to the increasing of effectiveness in agricultural production. Three groups of the procedures are distinguished: (1) Biological bases, (2) chemical, and (3) physical-environmental foundations. In the first group the following topics are dealt with: the growth of nutrition plants and plant hormones, root hormones, and of the above-ground parts; the role of hormones in the promotion of growth; somatic hybridization and genetic manipulation; the genetics of herbicid resistance; relationships between the yield of plants in the temperate zone and temperature effects, sink-source relations in fruit trees. In the second group the discussion is about the chemical possibilities of regulation in plant growth and development, and their relationship with world agriculture; the regulation of inducing the florescence and fruit growth of plants; the role of stimulating and inhibiting regulators in the early and late florescence of fruit trees; the relationship between the structure and effect of new growth-inhibitors; the possibilities of optimalization of new agrochemical materials in the nutrition processes of plants; the relationship in the dispersion of growth regulators and assimilates in plants; the role of stomata in the aging of leaves; the modern chromatographic methods used in the identification of plant growth regulators and in determining their quantities. In the third group, the questions of water stress, pre-treatment of seeds, and of C_4 photosynthesis are dealt with.

Another great part of the volume, the planning of future, contains two lectures. One of them, entitled Agriculture in 2000, discusses the perspectives of agriculture, and the other the targets of agriculture with a view of survival.

The volume is closing with the list of contributors, and with an author index, plant name index, and subject index, whereby enhancing orientation in the text. The layout of the book is excellent.

I. Précsényi

Plant Organelles (Edited by E. Reid). Ellis Horwood Limited, Chichester, West Sussex, pp. 1–232. Also obtainable from J. Wiley and Sons, New York, Chichester, Brisbane, Toronto, 1979.

This small but important book is based almost entirely upon papers presented and discussed at the 6th Subcellular Methodology Forum organized in 1978 by the Wolfson Bioanalytical Centre (University of Surrey, Guildford, England). The contributions from all over the world (except the socialist countries) have been collected and reviewed critically synthesizing the best methods for separating characterizing and differentiating the various plant cell components. The solution of such methodical problems is clearly very important for an understanding of the activities of the cell because they derive from or depend on the sophisticated dialectics of many cellular organelles, components.

The five papers of the first ("A") part of this booklet deal with the bioenergetic organelles (mitochondria and chloroplasts), and some of their constituting membranes. The authors of this part are: C. Jackson and A. L. Moore; S. P. Robinson, G. E. Edwards and D. A. Walker; C. A. Price, M. Bartolf, W. Ortiz and E. M. Reardon; C. Larsson and B. Andersson resp. R. Douce and J. Joyard. Part B ("Various organelles") begins with a non-methodical review of E. A. C. MacRobbie on development and function of plant vacuoles while the actual methods of isolating these organelles and their membranous fragments are given by R. A. Leigh, D. Branton and F. Marty. Other topics of part B are: developmental relationships of the endoplasmic reticulum with the glyoxysomes (J. M. Lord); the isolation of plant microbodies (E. L. Vigil, G. Wanner, R. R. Theimer), of plant microtubules (F. D. Hess and D. J. Morré) and of the Golgi apparatus (D. J. Morré and T. J. Buckhout). For workers engaged in plant growth research the papers of part C are highly interesting, among them that of P. M. Ray resp. of G. M. Lachlan, M. Dürr and Y. Raymond, both on membranes displaying glucan synthetase activities, then the paper of D. Marmé on the red light-induced association of phytochrome to membranes, finally that of R. Hertel on auxin binding sites on membranes. (Three such sites are tentatively characterized together with a fourth one that binds naphthylphthalamic acid.) But the chapter on plant lectins as membrane constituents is also important. Minor notes, contributions and discussion remarks made on the Forum and relating to the topics listed above are grouped at the end of the volume together with a somewhat longer paper — not read at the Forum — of C. A. Price on the isolation of plant nuclei. The concluding chapter (written by D. J. Bowles, P. H. Quail, D. J. Morré and G. C. Hartmann) and entitled "Use of markers in plant cell fractionation" is particularly useful because — by means of its recapitulative discussions and synthetic tables — it is easy to assimilate and use all the experiences in practice of the preceding papers. This is facilitated also by a good index. The layout illustrations are attractive.

All in all this is a unique booklet as to its scope, style, conciseness and comprehensiveness. It is an indispensable help for all those working in subcellular plant biochemistry but — due to its critical approach — is recommended to all those who are not directly involved in this line but have to evaluate and use its results for other purpose.

L. Pólya

Rains, D. W.–Valentine, R. C.–Hollaender, A. (eds): Genetic Engineering of Osmoregulation. Impact on Plant Productivity for Food, Chemicals, and Energy. — Basic Life Sciences series, vol. 14, Plenum Press, New York and London, 1980.

This age, I believe, can quite assuredly be called the age of stress impacts and prevention of stress. Because of the problems of global supply of food, agricultural production must be extended over increasingly greater areas where the climatic and soil conditions are not ideal and such productive varieties must be grown which are suitable for relevant field conditions. Therefore, ever more research centres are dealing with the capacities of microorganisms and of higher plants to adapt themselves to water deficiency; and with the questions of temperature effects, drought and the salt tolerance. Plants protect themselves from all these stress impacts with their osmoregulatory abilities.

With respect to osmoregulation, cells may be divided into two groups: those without cell walls and those with cell walls. It is characteristic of cells without cell walls, or those having extremely elastic cell walls, that they try to maintain a constant volume, while the cells havings cell walls have a constant turgor value independent of the osmotic potential of the external fluid. For both cell types, a biphasic osmoregulation is characteristic; if the environmental conditions of cells alter rapidly then the cells without cell walls react by an extremely fast change of volume; following this, a much slower process taking minutes or hours ensues when the cell approach their original volume. This volume correction is in general not completed and depends also on whether the external fluid was hypo- or hyper-osmotic. In the phase of rapid volume change, cells lose water since in this phase the water permeability of the membranes is much greater than that of solutes; thus, it is the concentration of osmotica that changes and not their absolute quantity.

Both cell types react to external factors immediately. The biology and genetics of these processes were dealt with on the Symposium held between 4 and 7 November, 1979, in Brookhaven National Laboratories. The proceedings of this Symposium are published in the present book.

The questions of osmoregulation were discussed in the following seven sections:

Section I — Osmoregulation in Procaryotic Microorganisms
Section II — Osmoregulation in Eucaryotic Organisms
Section III — Osmoregulatory Mechanisms in Plants
Section IV — Mechanisms of Drought and Cold Tolerance in Plants
Section V — Applications for Plant Improvement
Section VI — NSF-Cornell Workshop
Section VII — Discussion by National Research Agencies.

Rains and Valentine in their introductory lecture entitled "Biological strategies for osmoregulation" discuss how we can increase the productivity of biological systems under stress conditions. We have to understand the physiological, biochemical and genetical consequences of stress effects. Biological systems are able to adapt themselves to reduced water absorption, by taking up inorganic or organic materials or by synthetizing them i.e. by their osmoregulatory abilities. Naturally in a stress situation, the plant productivity will be influenced by the fact that a part of the energy originating from metabolism will be used for ion uptake and for the synthesis of organic materials.

It is an important finding that the osmoregulation of microorganisms and higher plants is extremely similar. The possibility of selection for new salt-tolerant plant varieties exists for higher plants, too. A long time ago our culture plants were adapted to stress conditions. Sumerians already grew barley in their saline soils, and in the Galapagos Islands a tomato species has been found which grows in the tidal zone and 6% of the dry weight of the leaves is Na^+.

In the cells of higher plants osmoregulation can be the consequence of the accumulation of either inorganic salts or organic molecules. The dominance of either the one or the other may vary even within one plant. In halophytes, the uptake of inorganic ions and their translocation is dominant. Inorganic materials accumulate primarily in the vacuoles. Cytoplasm is prevented from dehydration by the formation of osmotically active organic materials. The structure of the plasmalemma has to be specialized for taking up essential K^+ and for retaining excess Na^+ as well as for the prevention of the removal of the organic material produced. For example, *Avicenia marina*, which is a mangrove species, has such an absorption system which is capable of increasing the absorption of K^+ present in a much lower concentration, even at a high external Na^+ concentration. Tonoplast, on the other hand, has to secure a high salt concentration on its internal side, maintaining at the same time the concentration gradient between cytoplasm and vacuoles (Epstein: Responses of plants to saline environment).

The various species of bacteria in general react to osmotica by the absorption of L-proline, L-glutamic acid, and rarely that of γ-amino butyric acid. The L-proline content of the bacterial cell can be as high as 100 times that of the external environment. *Salmonella typhimurium* reacts to a relatively high concentration of various salts by reduction in its reproduction; the presence of a small quantity of L-proline in the external fluid decreases inhibition.

The other essential L-amino acids examined have no unequivocally positive effect, thus the role of L-proline in osmoregulation is specific in this microorganism.

The part played by proline in osmoregulation has not yet been fully clarified. Supposedly, owing to the great solubility of L-proline, the structure of water might be

changed, and the solubility of proteins might be increased under the conditions of reduced water potential. (L. CSONKA: L-proline and osmotic stress in *S. typhimurium.*)

In the osmoregulation of eucaryotic cells solutes are formed which are compatible with metabolism. In yeasts, fungi, and in the halotolerant flagellata *Dunaliella*, this material is glycerol. In the *S. rouxii* xerotolerant yeast as well as in *S. cerevisiae* non-tolerant yeast the formation of glycerol takes different pathways of metabolism (A. D. BROWN and Margaret EDGLEY: Osmoregulation in yeast). In the former, glycerol is produced by the pentose phosphate cycle and a modified glycolysis, while in the latter it is formed during glycolysis. In both cases glycerol derives from dihydroxyacetone-phosphate through glycerol-3-P, during the oxidation of NADPH resp. NADH.

A. BEN-AMATZ and M. AVRON held a lecture on the osmoregulation of two halophyl algae, viz. *Dunaliella* and *Asteromonas*. These cells have no cell walls. Their environment is such that they have to adapt themselves to alternations between high and low salt concentration. They grow optimally in solution containing 1 mol NaCl, but are capable of growing even in 4–4.5 mol of NaCl. It is therefore clear that in an osmotic balance such high salt concentration can not exist in the cells. The osmoregulator in these algae is glycerol too. The ratio of glycerol and chlorophyll is constant even in cells of different sizes.

The formation of glycerol was studied in detail under hypo- and hyperosmotic conditions. The process is very fast, glycerol is synthetized within minutes. Its formation is independent of protein synthesis, and it takes place in light and in dark as well. However, the signal which triggers the osmoregulatory response is still an open question. It is by all means the membrane where a change must take place. In the formation of glycerol, the $NADP^+$-specific enzyme, dihydroxyacetone-reductase plays a part, and also dihydroxyacetone -kinase. The C-frame of glycerol derives from polysaccharides, and so in the breakdown of starch and with increasing salt concentration, the formation of O_2 independent of CO_2 can be measured.

In: J. A. RAVEN, F. A. SMITH and S. E. SMITH: 'Ions and osmoregulation' the evolution of the ionic composition of the cytoplasm is discussed with respect to procaryotic and eucaryotic marine and fresh water organisms. The ionic composition of the cytoplasm is in general characterized by K^+ concentration surpassing the concentration of Na^+, and the quantity of free Ca^{2+} and H^+ is about 0.1 μM. Aside from organic anions (carboxylates, phosphates), the quantity of anorganic anion (Cl^-) is very small. The composition of the vacuole content is more varied. The capacity to regulate turgor and the regulation of pH^- — the consequences of NH_4^+ and NO_3^- nutrition and of Fe-deficiency—raise different problems of metabolism. Undoubtedly, the ion-content and osmotic values of plants getting NO_3^- nutrition are higher than in plants getting NH_4^+-nutrition.

In terrestrial plants, a very interesting question is the ion-supply (osmoregulation) of the above-ground parts. The regulation can take place through the roots through absorption and efflux of ions into the xylem and through functioning of the salt glands. The experimental results showed that the most important part in the regulation is played by the absorption into the xylem in the root. The authors raise very important questions concerning the origin of the organic acid content of the shoot and the question of NO_3^--reduction→organic acid formation and translocation, in the leaf. The root cells effluate the forming H^+, OH^-, HCO_3^- into their external environment, but what happens in the leaf cells?

R. L. JEFFERIES: Organic solutes in osmoregulation in halophytic plants. Compatible osmotica have been compared in several seacoastal halophytic plants but the list is not at all complete yet. It is very interesting that in eucaryotic cells, the high salt concentration inhibits the activity of enzymes in halophytic, salt-tolerant and non-tolerant plants to the same extent. Two types can be distinguished among halophytic plants. Some species maintain a nearly constant potential gradient between the leaf and the external fluid, while in the other type, in the case of an increase in the salt content of the external fluid, the osmotic potential of the leaf drops quickly, then it remains constant.

It is not at all certain whether the osmotica that have accumulated are actually osmoregulators or they regulate the structure of water. The two extreme examples of their solubility in water is proline, which is easily soluble in water, and glycerol, which is less easily soluble in water. The role of osmotica in metabolism is also interesting; proline is easily metabolized if the water stress ceases, while betaine is a stable end-product of metabolism.

Since in higher plants the most different materials accumulate, it is difficult to believe that all of them are the result of positive adaptation. (R. GARETH and WYN JONES: Quarternary ammonium as osmotic effector in crop plants.) It seems to be sure that the accumulation of glycine-betaine in certain species can be considered to be of such an origin.

Proline begins to accumulate in the plant when the growth of the plant is already a little inhibited. We have to distinguish a generally occurring proline accumulation in the

plant tissues during water stress from its specific accumulation characteristic of certain halophytic plants. Unfortunately, in cereals the supposition that from the proline content inferences can be drawn on salt-tolerance could not be confirmed.

The other lectures of the symposium — in my judgement — present a theoretical basis for research serving practical purposes in our country. (OSMOND, C. B.: Integration of photosynthetic carbon metabolism during stress; VEEN, B. W.: Energy cost of ion transport.)

Since in our country too, the problems of stress have more and more come into focus two further lectures of the book deserve a detailed study, viz. RAINS, D. W.–CROUGHAN, T. P.–STAVAREK, S. J.: Selection of salt-tolerant plants using tissue culture; NORLYN, J. D.: Breeding salt-tolerant crop plants.

The material of the book is of a modern approach; providing especially valuable help with its ample citations of the literature, and would by all means be worthwhile for experts in practice dealing with drought- and salt-tolerance.

E. CSEH

HALFON, Efraim (ed.): Theoretical Systems Ecology. Advances and Case Studies. Academic Press, Inc. pp 516. New York–San Francisco–London, 1979.

After glancing through the book, we involuntarily ask the question whether it is not that the main problem related to researches into theoretical biology is still the circumstance that the researches are carried on rather isolatedly. Here I think not only of spatial isolation: with respect to the elimination of the latter, this work is of exceptional importance. The publishers, presenting the work of 28 authors in 20 chapters, begin the book with enumerating the contributors. It turn out that the editor, the Canadian HALFON, collected — in addition to the works of American theoretical ecologists — the works of Australian, Italian, Finnish, French and even Soviet researchers.

Since even a simple enumeration of all the chapters would overgrow the framework of a book review, I divide the message of the book into 3 main parts.

The first group of questions deals with the structure, organization and aggregation of the ecological system (Chapters 1–3). A mathematical apparatus can already be discovered here, but primarily only in connexion with the discussion of the errors of data collection, and in accordance with the viewpoints of planning the experiments and of sampling (e.g. in Chapter 3).

The second group of questions is devoted to the problems of model building and model theory (Chapters 4–9). Here, beyond the discussion of the hierarchical structure of ecosystems, the questions of correlation between structure and stability resp. structure and adaptability are dealt with, too.

Chapter 9 leads us to the problematics of model-validation, and the rest of the chapters (10–20) can be grouped into this sphere of topics. Here mention is made not only of the methods of control theory and model analysis but also of the possibilities of structural identification of linear compartment models; in discussing the possibilities of computer techniques, the instruments of artificial intelligence also take their place in the category of theoretical methods for systems ecology.

After analyzing some of the chapters, I have become convinced that the proportion of re-discovering is still very considerable, and the proportion of such scientific results that are really original, i.e. considered new, is small. Almost all the chapters go through such phases of the modelling process as the system compartments and the quantitative definition of relationship between them, then the description of qualitative relations, which is followed by the modelling phase. It is mostly the compartment analysis concept that is applied, and in spite of the fact that this already requires an exact, mathematical description, the reader can by far not be convinced that this is the only suitable way of exactly describing and predicting the temporal behaviour and changes in ecosystems. Here crops up the necessity of model verification or in other words model validation the *sine qua non* of which is predictability. In this respect, the modelling method of IVAHNYENKO, member of the Ukranian Scientific Academy, and of his co-workers is exceptionally valuable. Although we can agree with ZADEH (ZADEH and POLLAK eds, pp. 3–42, 1969, McGraw-Hill), according to whom: "the momentary state of the system carries all the information of its past which is revelant to its future behaviour", IVAHNYENKO — besides giving the information obtained on the momentary state of the system — summarizes, obviously by means of a computer, the predictions made in several periods on the system, because he wants to reach the stage of "foretelling the predictions". This conception does not exaggerate the truth content of past statements but it does not

underestimate it either; the truth content is put into place in the evolutionary process in which an ecosystem takes part.

I should mention here the interesting circumstance that IVAHNYENKO used his method first for calculating and obtaining prognostications, which were considered reliable, in relation to economic systems. This confirms my experience that system-ecological problems manifest a great number of analogies with economic systems and, it seems, the econometrical specialized literature covers several examples related to the problematics of prognostications.

In spite of the frequently different mathematical formalisms, constituting a considerable portion of the work, the book can be recommended not only to mathematicians but to all the researchers who are not discouraged by exact logics, and are interested in the complicated interconnexions between ecological systems. Let us mention for them Chapter 8 dealing with the ecosystems of continental shelf (PATTEN and FINN); Chapter 14 discussing lake ecosystems (WATSON and LOUCKS); Chapter 17 describing the methods of river pollution control (SINGH). It is primarily the examples of water ecosystems that can be found in the book, probably because the publisher himself is also a leading co-worker of the Canadian "National Institute for Water Research".

A. EŐRY

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К. БАБОШ, И. Р. БЕРМУДЕЗ, Л. И. С. КУМАНА

Авторы описывают характерные анатомические свойства ксилемы 4 венесуэльских видов *Capparis*, а также их морфологические, экологические свойства и место произрастания. Изученные виды: *Capparis coccolobifolia* Mart. ex Eichl., *C. hastata* Jacq., *C. indica* Druce, *C. linearis* Jacq.

ИЗУЧЕНИЕ ТРИБЫ RONDELETIEAE (RUBIACEAE) I НОВЫЙ РОД ROIGELLA

А. БОРХИДИ, М. ФЕРНАНДЕЗ ЗЕКЕЙРА

Авторы провели подробные изучения структуры завязи, плода и пыльцы у видов рода *Rondeletia* L. На основании полученных данных авторы вновь описали современный диагноз рода *Rondeletia* Было определено, что по строению плаценты, по структуры пыльцы и по отверстию в плоде *Rondeletia. correifolia* Gr. отличается от видов рода *Rondeletia* L. и поэтому его относят к новому роду под названием *Roigella* Borhidi et Fernandez. Новое название вида: *Roigella correifolia* (Griseb) Borhidi et Fernandez.

ИЗУЧЕНИЕ ТРИБЫ RONDELETIEAE TRIBUS (RUBIACEAE) II. НОВЫЙ РОД SUBERANTHUS

А. БОРХИДИ, М. ФЕРНАНДЕЗ ЗЕКЕЙРА

Авторы определили, что секция *Stellatae* рода *Rondeletia* по строению завязи, по форме плаценты и по морфологии пыльцы, значительно отличается от рода *Rondeletia*. Сроение плода и форма семени совсем иная. Новый род был описан под названием *Suberanthus Borhidi et Fernandez* и его относят к трибе *Cinchoneae*. К новому роду относятся 5, ранее описанных видов: *Suberanthus neriifolius* (A. Rich.) Borhidi et Fernandez, *S. stallatus* (Griseb.) Borhidi et Fernandez, *S. brachycarpus* (Griseb.) Borhidi et Fernandez, *S. canellifolius* (Britt.) Borhidi et Fernandez и *S. yumuriensis* (Britt.) Borhidi et Fernandez.

НОВЫЙ ВИД *VERBENACEAE* ИЗ КУБЫ: *CITHAREXYLUM MATHEANUM* SP. N.

А. БОРХИДИ, З. КЕРЕСТИ

Новый вид *Cytharexylum* произрастает в горах Ескамбрай местности в средней Кубе. Автор этот новый вид назвал в честь заслуженного венгерского ученого ботаника академика Имре Мате *Citharexylum matheanum* по случаю его семидесятилетия.

ВЛИЯНИЕ ОКРУЖАЮЩЕЙ СРЕДЫ МАТОЧНОГО РАСТЕНИЯ НА ПРОРАСТАНИЕ СЕМЯН *CASSIA SOPHERA* VAR. *PURPUREA*

ДАТТА Ш. Ц. СЕН СОНА

Среди различных экологических факторов в которых живут маточные растения *Cassia* три фактора явились сигнификантными с точки зрения контроля прорастания семян. Эти факторы: тип семени, время посева и снабжение водой.

ДИНАМИКА РОСТА КАЛЛУСА ПОЛУЧЕННОГО ИЗ КОРНЕ И ЛИСТЬЕВ *DATURA INNOXIA* MILL.

НГУЕН Н. ДУНГ, Е. СЕКЕ, Г. В. ПЕТРИ

Культуры тканей *Datura innoxia* чувствительно реагируют на изменение пропорции 2,4-Д и кинетина, находяшихся в питательной среде. Авторы на основании измеренной биомассы считают оптимальным применение 1 мг/л кинетина и 1 мг/л 2,4-Д. В случае использования более низкой или высокой концентрации ауксина и кинетина ткани росли менее интенсивно. Авторы также изучали динамику роста каллусных тканей, полученных из корней и листьев *Datura innoxia* на основной среде Мурасиге-Скуг (1 мг/л кинетих и 1 мг/л, 2,4-Д (и растущих в темноте. Были измерены свежий и сухой вес каллуса за инкубационный период (8 недель), а также измеряли скорость роста. Авторы определлили, что оба типа каллуса за 8 недель нормально росли. На 6 – 8 неделе развития рост замедлился, вернее совершенно прекратился. Каллус, происходящий из корней на свету рос хуже, чем в темноте. В тоже время каллус, происходящий из листа, на свету рос интенсивнее.

В данной работе авторы наблюдали дифференцировку и анатомические свойства каллуса.

КРАТКОЕ ОБОЗРЕНИЕ СООБЩЕСТВ СОРНЫХ ТРАВ ЗАПАДНОЙ СЛОВАКИИ

П. ЕЛИАШ

Автор дает краткую характеристику нитрофильных сообществ сорных трав в рамках синтаксономии. Обсуждаемые 90 ассоциаций относятся к следующим классам: *Bidentetea tripartiti* Tx., Lohmeyer et Prsg. in Tx. 1950; *Sisymbrietea officinalis* Gutte et Hilbig 1975 em. *Meliloto-Artemisietea absinthii* Eliaš 1980, *Artemisietea vulgaris* Lohmeyer, Prsg. et Tx. in Tx. 1950, *Agropyretea repentis* Oberdorfer, Th. Müller et Görs in Oberd. et al. 1957, *Polygono – Poetea annuae* Rivas–Martinez 1975 and *Molinio-Arrhenatheretea* Tx. 1937 em. 1970.

РЕПРОДУКТИВНАЯ АЛЛОКАЦИЯ В СТАДИИ ПЕСЧАНОЙ СУКЦЕССИИ

Г. ФЭКЭТЭ, Е. МЕЛКО

Авторы изучали репродуктивную аллокацию (RA) у двух многолетних (*Festuca vaginata* и *Alyssum montanum* ssp. *gmelinii*) и двух однолетних (*Arenaria serpyllifolia* и *Silene conica*) видов в стадии песчаной первичной сукцессии. Выбранные особи были разделены на фертильную-, ассилирующую- и корневую массу. Авторы также определили и массу компетиторов в сообществе. Релативная оценка RA у каждого вида различна по стадиям сукцессии. Факторы, влияющие на вариабильность RA изучались при помощи анализа-path. У однолетних видов прямое влияние ассимилирующего веса в каждой стадии было значительное, а вес корней зависит также, как и ценологическое влияние (влияние других видов). У многолетних видов внутреннее влияние RA (фертильного веса) в разных стадиях различное. В завершенной стадии растительности в вариабильности веса фертильных частей двух многолетних видов играли роль не только внутренние, но и ценологические факторы, более того это внешнее влияние в случае *Festuca vaginata* становится доминантным.

НОВЫЙ РОД ЗЕЛЕНОЙ ВОДОРОСЛИ *CHLOROMIRUS*, НАЙДЕННЫЙ В ДУНАЕ

Т. ХОРТОБАДЬИ

Автор в 1973 году опубликовал *Chlorococcales* под именем *Nephrocytum sp.* Этот редкий вид был найден и 1974 году в большом количестве в различных ценобиях и с размножающимися клетками. На основании этих исследований эта водоросль оказалась новым родом, который автор описал под названием *Chloromirus.* В этот же род автор причисляет вид *Hydrocystis hydrophila* TURNER и *Chloromirus hydrophylus* (TURNER) HORTOB. comb. n.

НАДЗЕМНАЯ ПРОДУКЦИЯ NETTO КУСТАРНИКОВЫХ ЯРУСОВ В ДУБОВОМ ЛЕСУ (*QUERCUM PETRACEAE-CERRIS*) В ШИКФЕКУТ (СЕВЕРНАЯ ВЕНГРИЯ)

И. КАРАС

Автор изучал ярус кустарников, состоящий более из 93 тысяч особей на гектар, разделив их на два подяруса. Авторы измеряли надземную продукцию **netto** в высоком ярусе у шести. в низком ярусе у 10 доминантных и у фреквентных видов, при помощи способа «среднего кустарника» в различных фракциях (листья, годичная лоза, ветвь + ствол, плод, цветок). Результаты по обработке листьев относятся к 1973, 1978 и 1979 году а остальные к 1973—79 годам. Сухой вес надземной продукции **netto** кустарников 1,347 · 30 кг/га$^{-1}$. Из этого в низкоярусных кустарниках 172,24 кг (12,75%) а в высоких кустарниках 1,176 · 06 кг (87,25%). Большую часть продукции кустарников дает лиственная продукция (44,57% – 600,17 кг/га$^{-1}$). Примерно одинакова продукция годичной лозы (341,73 кг/га = 25,33%) и продукция ветви + ствол (402,42 кг/га$^{-1}$ = 29,88%). Средняя дневная продукция кустарников = 0,67 гм$^{-2}$ · 71,47% образуется в двух доминантных видах высокоярусных кустарников *Cornus mas* и *Acer campestre.*

PROBREVAXONES — НОВАЯ ГРУППА ПЫЛЬЦЫ ДЛЯ ПЕРВОГО ФОРМЫ-РОДА *BREVAXONES* ИЗ ПОРТУГАЛЬСКОЙ ВЕРХНЕ — ЦЕНОМАН ЭРЫ

М. КЕДВЕШ, Ф. ДИНИЗ

В слоях **Vila Flor** Верхнего Ценоман было найдено большое количество пыльцы **Brevaxones** у которой авторы наблюдали ареал слабого прорастания. У этой пыльцы отверстие прорастания **tricolporate**, **vestibulum** и без диференцировки. Внешнее отверстие представляло собой сравнительно короткую борозду, которая не имела интратектальной или основной сепарации. Авторы описывают новые таксоны, среди которых новыми формами-родами являются следующие: ***Bolchovitinaepollenites***, ***Laingipollenites***, ***Samoilovichaepollenites***, ***Medusipollenites*** и ***Vilaflorpollenites.*** Изучение формы пыльцы показывает, что эти роды-пыльцы находятся на таком уровне развития, из которых развиваются большинство различных форм. Между **tricolporate** ***Longaxones*** и ***Brevaxones*** можно найти переходные формы. С этой точки зрения ясен гетерогенных характер ***Normapolles.***

МИКРОСКОПИЧЕСКИЕ ИССЛЕДОВАНИЯ МАСЛЯНЫХ ЗЕРЕН КУБИНСКИХ ПЕЧЕНОЧНЫХ МХОВ

Г. КИШ, Т. ПОЧ

Авторы исследовали масляные зерна у 27 видов печеночных мхов, собранных на Кубе, и из которых 18 видов были описаны и зарисованы впервые. Данные относящиеся к масляным зернам родов ***Anomoclada***, ***Bonneria*** = ***Leucosarmentum***, ***Micropterygium***, ***Symphyogyna*** совершенно новые. Наряду с обобщением литературных данных, авторы сделали выводы по таксономии, основанные на данных, полученных при изучении масляных зерен мхов.

РАЗНООБРАЗИЕ И ПЕРЕМЕННАЯ-NICHE У КУСТАРНИКОВЫХ ВИДОВ НА ОКРАИНЕ ЛЕСА

И. МЕСАРОШ, П. ЯКУЧ, И. ПРЕЧЕНЬИ

Авторы статьи изучали переменные разнообразия кустарниковых видов (вид-особь, вид-относительное покрытие) на окраине леса образовавшейся на месте встречи дубового леса и виноградника в **ecotone** при помощи **transect**, а также были изучены переменные **equitability** и **evenness**, следуя от самого края в глубину леса. В том же самом направлении авторы изучали переменную ширины-**niche** и **overlap** в **transect** на оси-**niche**. Ось-**niche** может соответствовать «световым взаимоотношениям».

Упорядоченность кустарникового яруса растет в сторону глубины леса как показывает переменная разнообразия вид-относительное покрытие. Следуя по направлению глубины леса некоторые виды (***Cornus mas, Acer tataricum, Ligustrum vulgare***) занимают большую часть площади-**niche** и у них имеется конкурентное превосходство по сравнению с другими видами. При закрытии лиственной кроны ширина-**niche** у большинства видов сужается. Из полученных результатов авторы делают вывод, что в изученном лесу максимальная ширина окраины леса — около 8 метров. От этого расстояния в глубину леса отношения кустарник-структура уже характерны для внутренней части леса.

НОВЫЕ ВИДЫ РОДА *COCCOTHRINAX* (*PALMAE*) НА КУБЕ

О. МУНИЦ, А. БОРХИДИ

В результате ревизии кубинских видов рода *Coccothrinax* авторы открыли 7 новых видов и 1 новый подвид, которые описаны в данной статье. Это следующие виды: ***C. baracoensis*** **Borhidi et Muñiz sp. n.**, ***C. camagüeyana*** **Borhidi et Muñiz sp. n.**, ***C. elegans*** **Muñiz et Borhidi sp. n.**, ***C. leonis*** **Muñiz et Borhidi sp. n.**, ***C. microphylla*** **Borhidi et Muñiz sp. n.**, ***C. nipensis*** **Borhidi et Muñiz sp. n.**, ***C. yunquensis*** **Borhidi et Muñiz sp. n.**, ***C. crinita*** **ssp.** ***brevicrinis*** **Borhidi et Muñiz ssp. n.** На основании дальнейших результатов ревизии авторы считают действительными видами 6 таксонов, которые раннее были описаны, как внутривидовые таксоны. Эти виды следующие: ***C. cupularis*** **(León) Muñiz et Borhidi status n.**, ***C. guantanamensis*** **(León) Muñiz et Borhidi status n.**, ***C. macroglossa*** **(León) Muñiz et Borhidi stat. n.**, ***C. moaensis*** **(Borhidi et Muñiz) Muñiz status n.**, ***C. orientalis*** **(León) Muñiz et Borhidi stat. n.**, ***C. savannarum*** **(León) Borhidi et Muñiz stat. n.**

РЕДКО РАСПРОСТРАНЕННЫЙ НА ТЕРРИТОРИИ ВЕНГРИИ МЕЖВИДОВОЙ ГИБРИД *POLYSTICHUM*, *P.×LONCHITIFORME* (HALÁCSY) BECHERER (= *P. LONCHITIS×P. SETIFERUM*)

Г. ВИДА и З. ПИНТЕР

Авторы нашли в Венгрии гибрид ***Polystichum***, который сначала определили, как ***P.×illyricum***. Хромосомное число в митозе указало на диплоидный уровень: 2 n = 82. В мейозе было найдено 40 унивалентов и 21 бивалент. Соответственно этому этот гибрид является следствием диплоидной комбинации, т. е. гибрид ***P. lonchitis×P. setiferum***) = ***P.×lonchitiforme*** новый для венгерской флоры.

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HU ISSN 0001—5350

Index: 26.006